SCIENTIFIC AMERICAN

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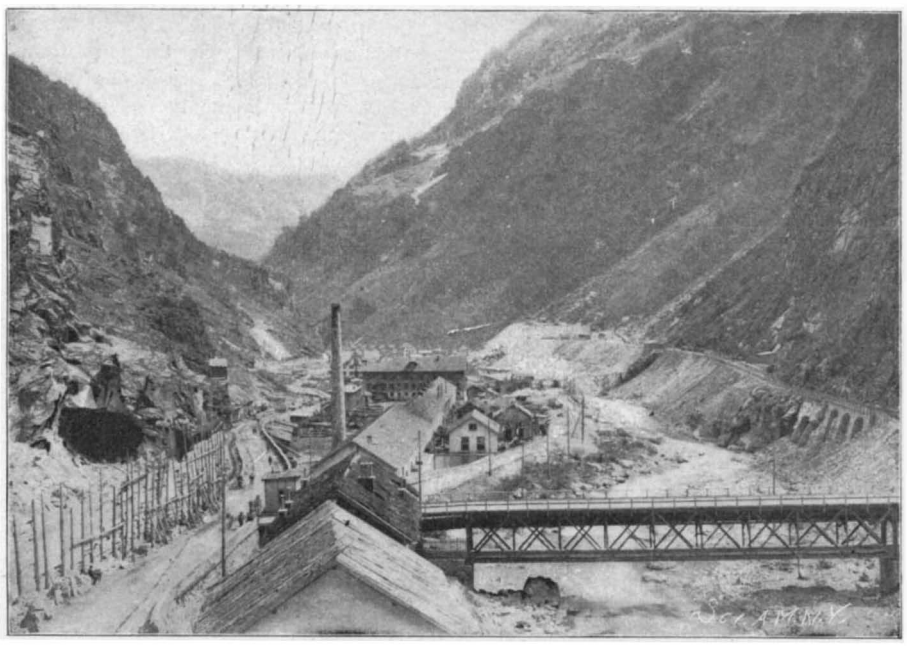
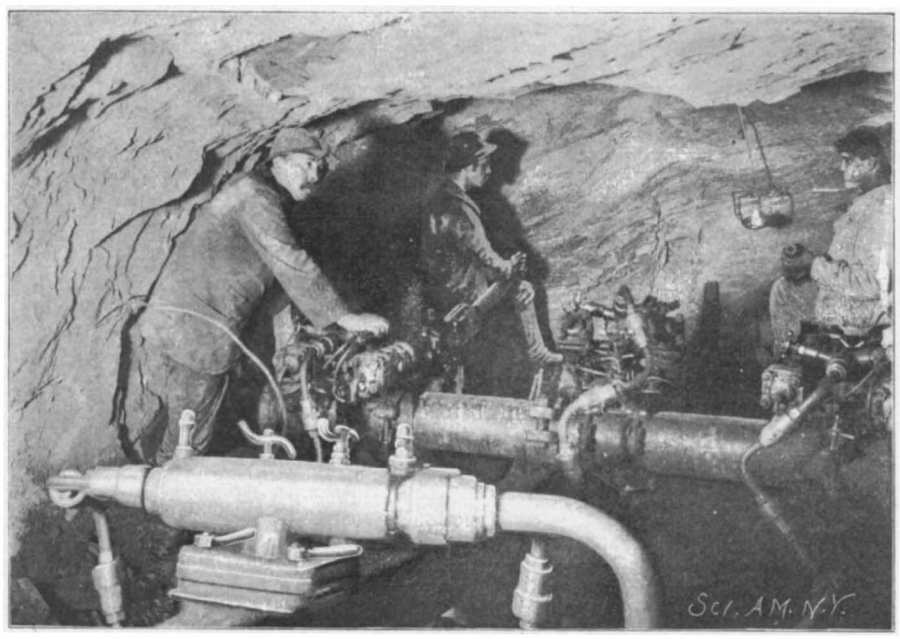
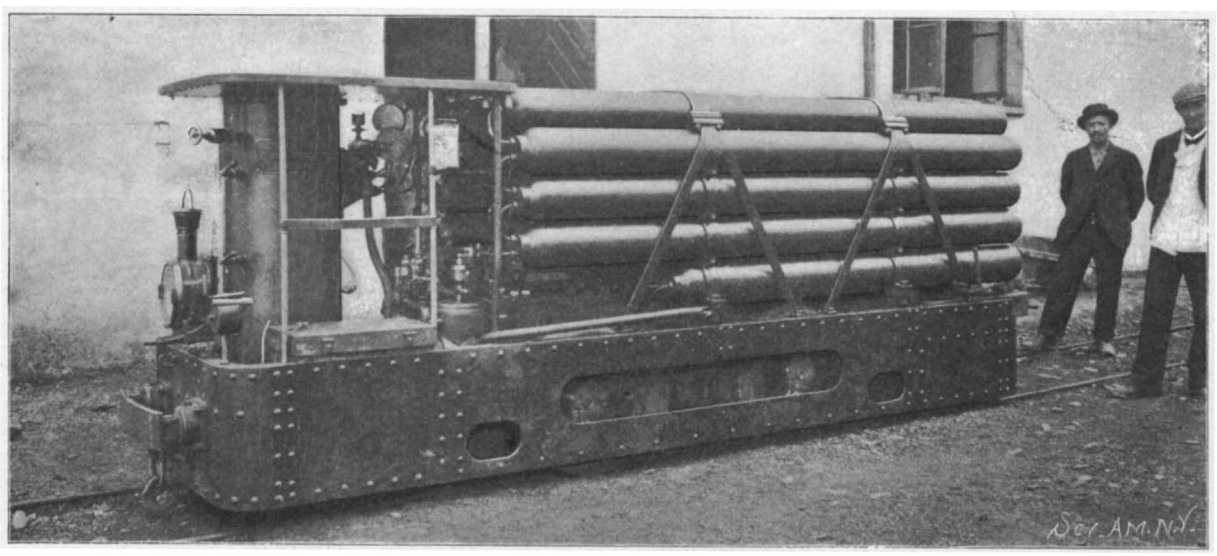


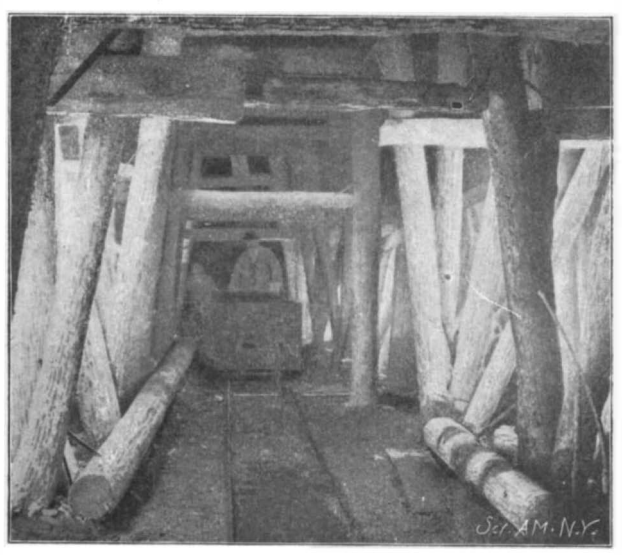
Upper Power House. Iron Bridge Across the Diveria for the Flume. To the Left, a Small Tunnel Leading to the Main Tunnel.



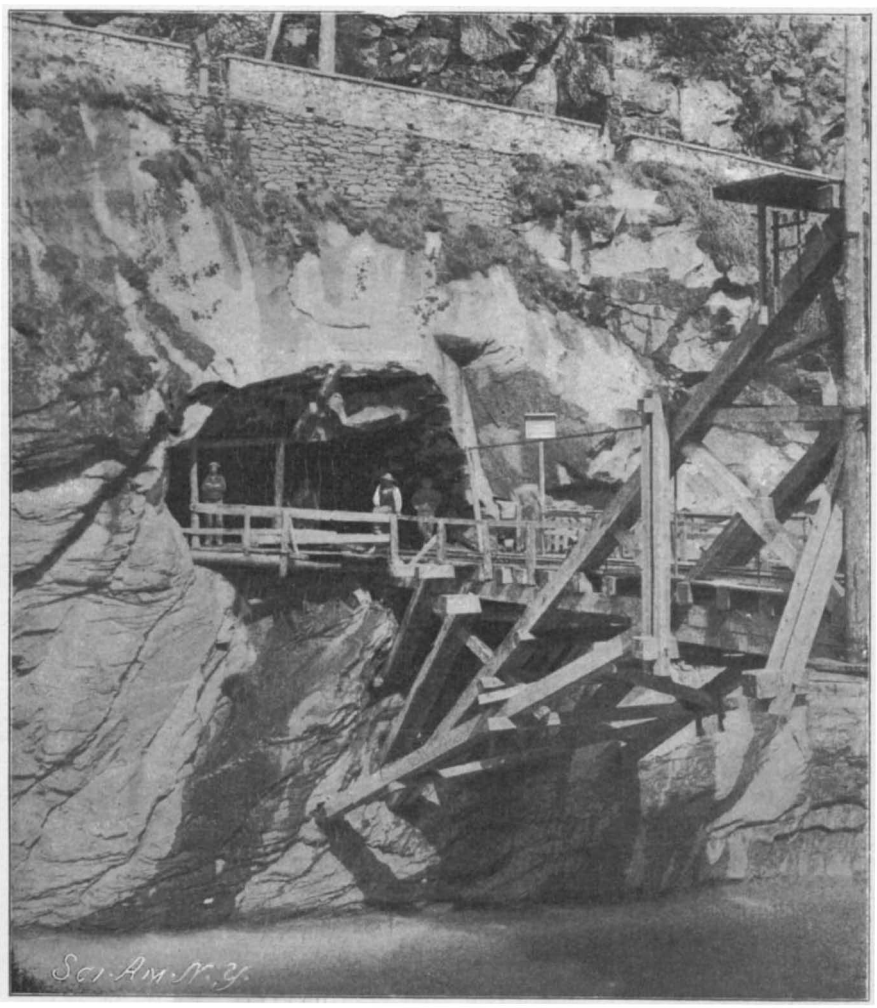
Three Brandt Hydraulic Rock Drills.



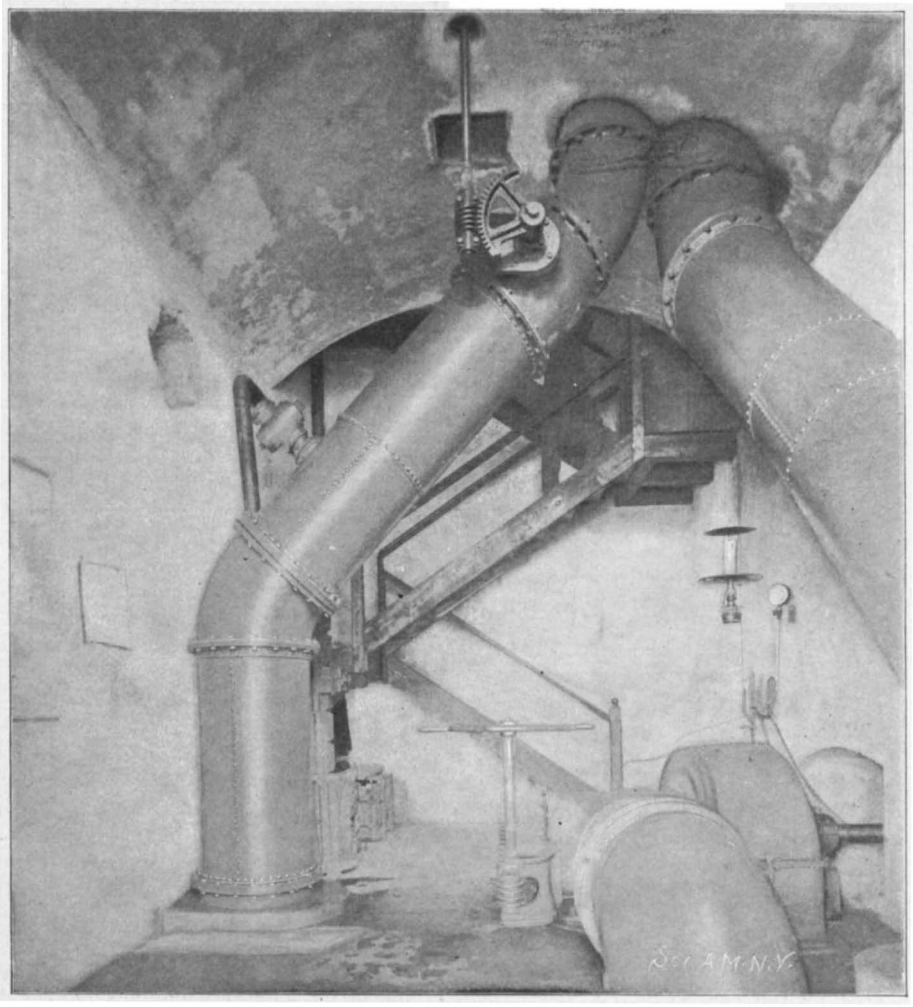
Compressed-Air Tunnel Locomotive.



Interior of the First Tunnel.

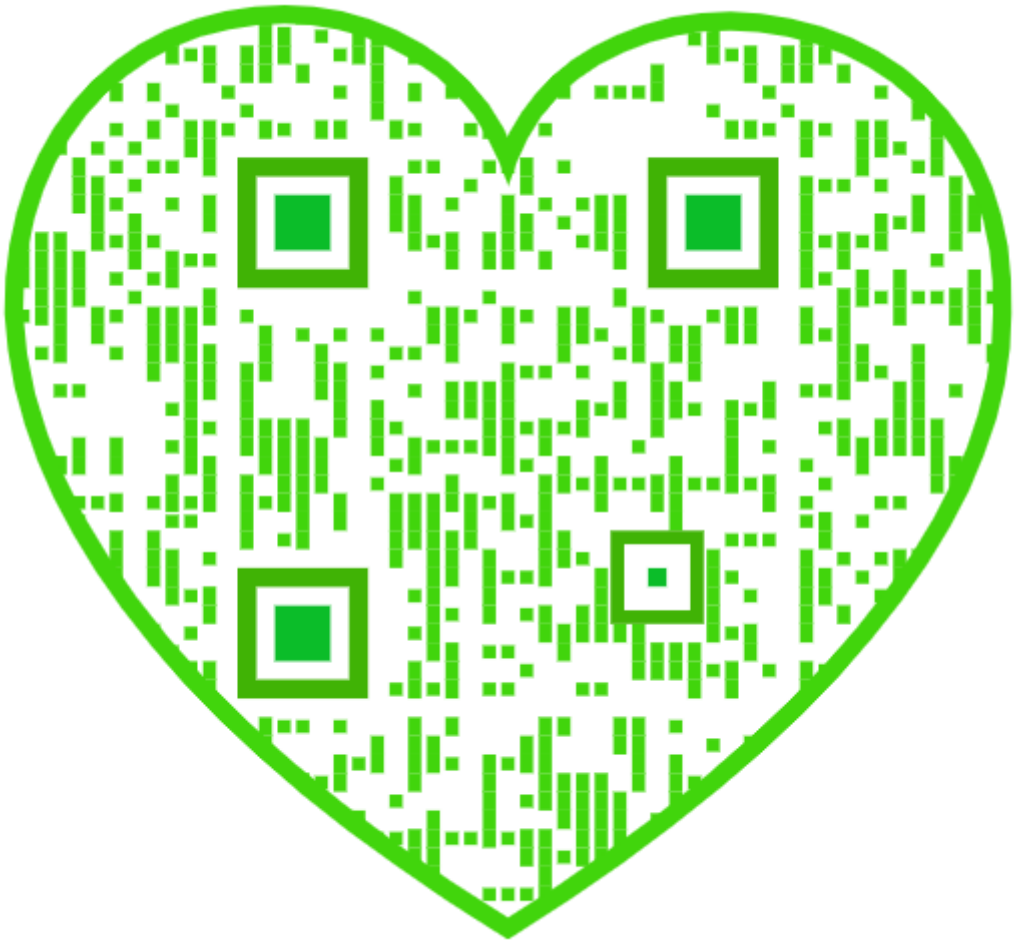


Entrance to a Gallery on the South Side, Showing Bridge Across the Diveria.



Interior of Ventilator-House.

WORK ON THE SIMPLON TUNNEL.—[See page 313.]



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NEW YORK, SATURDAY, NOVEMBER 16, 1901.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

PROPOSED INCREASE OF THE NAVY.

The recommendations of the Naval Construction Board, which have now been laid before Secretary Long, call for the addition of no less than forty warships to the United States navy. The most important element is, of course, the battleships and the cruisers, the Board recommending the construction of three of the former, each to be of 16,000 tons displacement, and two armored cruisers of 14,500 tons displacement. The design of battleship recommended is practically that adopted by the majority report of the Board on Construction. It follows the general lines of that most admirable design the "Maine" the chief points of difference being the substitution of the new 7-inch for the 6-inch gun in the broadside battery, and the increase of the number of guns from sixteen 6-inch up to twenty 7-inch. It will thus be seen that we have returned from the "Georgia" type, with its much-debated double turret, to the simpler and more conservative arrangement of the "Alabama" and "Maine" classes. The two armored cruisers will probably carry as their main armament four 10-inch breech-loading guns in place of the four 8-inch which form the main battery of the "California" class. These vessels will unquestionably be the heaviest armed and armored ships of their respective classes in the world.

The Board also recommends the construction of six gunboats of about 1,200 tons displacement, six of 600 tons and six of 200 tons. The provision of these boats was prompted by the necessities of the naval situation in our foreign possessions, more particularly in the Philippine Islands, where there is a great demand for a handy, light-draft vessel for blockade and police duties. Another provision which cannot be too highly commended is that for two huge colliers of no less than 15,000 tons displacement each; while those friends of the navy who believe that our bluejackets should be sailors in the full sense of the term will be pleased to know that the construction of six training ships of about 2,000 tons displacement is also recommended. There is a call for four picket-boats of about 650 tons and four tugboats. When this programme of construction is submitted to Congress it will have before it the latest section of a carefully-thought-out scheme for providing the United States with a navy made up of the proper number and proportion of various units to compose a thoroughly harmonious and well-balanced whole. The recommendations have the indorsement of what is known as the General or Dewey Board, as well as that of the Board on Construction. We sincerely hope that when Congress comes to pass upon them, the members of that body will be satisfied to be guided by the judgment of men, who are qualified by their professional knowledge and long experience to have the last say upon the question of the types of ships and general make-up of the United States navy. The question of appropriations rightly belongs to Congress itself.

THE TUNNEL BETWEEN SCOTLAND AND IRELAND.

The proposed railway tunnel between Scotland and Ireland, judged as one element of the general scheme or schemes which are now being mooted for shortening the distance of the ocean passage between Europe and America, is placed in somewhat the same category as the late Austin Corbin's dream for the creation of a great terminal port at Montauk, at the eastern end of Long Island; there being this difference, however, that when judged on that ultimate basis to which all such schemes must come—financial practicability—the Scotland and Ireland tunnel is even less feasible than Corbin's project. The cost of the tunnel is estimated by the contractors at $50,000,000, exclusive of interest, and, as matters now stand, there is not nearly sufficient traffic, either freight or passenger, to enable the scheme, if completed, to earn interest on the cost of construction. Nevertheless, in view of the rapid growth of commerce and the vast accumulation of capital seeking investment, it is conceivable that conditions may arrive in some future day that will guarantee the construction of a 34½-mile tunnel such as this.

The engineering features of the tunnel were discussed recently in a paper read by James Barton, M.I.C.E., before the International Engineering Congress at Glasgow. Of the three possible locations for the tunnel, the one selected lies between Wigtonshire, Scotland, and the Irish coast, at a point where the distance from shore to shore is within 23 miles. The maximum depth of water varies, according to the line selected, between 480 and 900 feet. The route forms a through line between Carlisle and Belfast, and has the advantage of providing the best route from Scotland to the whole of Ireland, and from the North of England to Ireland. The survey for the tunnel proper commences five miles from Stranraer railway station and finishes five and a half miles inside the shore line of the Irish coast, the total length of the tunnel being thirty-four and a half miles. Leaving the tunnel, the line extends for ten and a half miles to the city of Belfast. The total length from Stranraer to Belfast is fifty-one and a half miles, thirty-four and a half of which is tunnel, and twenty-five of it beneath the sea. The roof of the tunnel will lie one hundred and fifty feet below the sea bottom. The proposed heading is seven feet high by ten feet wide. It is expected that the portion of it which is driven through the Silurian will be cut as rapidly as the Simplon tunnel, while progress through the Keuper marls is expected to be more rapid. It is estimated that the whole of the heading would be completed in less than ten years and the tunnel finished in about twelve years. This estimate is based upon a comparison of the speed of driving four notable tunnels. The Mont Cenis was driven at the rate of 6 yards a day, and at a cost of $1,120 per yard. In the St. Gothard the maximum speed was 10 yards a day, at a cost of $710 per yard. In the Arlberg the maximum speed rose to 12 yards per day, while the cost was reduced to $535 per yard; and it is expected that on the Irish tunnel, judging from the quality of the material to be passed through and the improved methods now being used on the great Simplon tunnel, the speed will be increased and the cost per yard reduced still further. As to the question of water entering the tunnel, although the uncertainty on this point is admitted, the author of the paper does not consider that the difficulty will be a serious one. No water leakage in any great quantity occurred during the construction of the Severn or the Mersey tunnel, at least in those portions of these tunnels that were immediately beneath the sea; and it is believed that the sea bed below the Irish tunnel has probably closed all faults in the rock sufficiently to keep out sea-water in any but easily-handled quantities. The line will be operated electrically from power stations located near the main shafts at each end of the tunnel; and it is proposed to run trains at a speed of from 60 to 70 miles, thereby reducing the time in the tunnel to about half an hour.

THE PROBLEM OF THE LOCOMOTIVE BOILER.

In the controversy over the respective merits of British and American locomotives, there is no point of comparison on which the two types have been found to differ so widely as on the most essential one of boiler capacity. It will probably be within the truth to say that in a comparison of a hundred locomotives of each type it will be found that fully one-half of the American locomotives has over a hundred per cent more heating surface in its boilers, and that the other half has from thirty-five to forty per cent more heating surface than that of the British engines. From an early day in the development of the locomotive our builders have realized that all improvements looking to an increase of power and capacity must begin with the boiler; and it is to the fact that our locomotives are never over-cylindered, that is to say, that the boilers are able at all times to supply an abundance of dry steam, even under the most excessive demands, that we must attribute, more than to any other cause, the much greater hauling capacity of the American type. The average express locomotives to-day on first-class American roads will have 2,000 square feet of heating surface, and the latest expresses for hauling fast trains carry not less than 3,000 square feet, the most powerful of them all; the new Atlantic type on the New York Central Road, having a total of 3,505 square feet. Comparing this with the latest powerful express engines in Great Britain we find that the most powerful freight engine has only 2,500 square feet of heating surface, as against 3,805 square feet in the big freight engines used in the ore traffic from the Lakes to Pittsburg, while there is an even greater discrepancy between the new six-coupled express engines on the North-Eastern Railway, England, and the New York Central express engine above mentioned. The British type has cylinders 20 by 26 inches and 1,700 square feet of heating surface, whereas the New York Central engines have cylinders 21 by 26 inches, with, as we have said, 3,505 square feet of surface. In comparing the last two, the American builder wonders how in the world the North-Eastern boiler can provide steam enough for its cylinders. Of course, the coal is superior, and there may be some advantage in the copper firebox, though this cannot amount to very much.

Enormous as the boilers of American locomotives are, it is certain that the demand for increasing power will continue, and our builders must be prepared to make some radical changes if they are to meet this demand. The present type of boiler has grown to such a size that it cannot be increased much further within the limits prescribed by the size of the tunnels and clearance of platforms. What is required is a boiler with a larger steam-raising capacity for a given bulk, and the indications point to the adaptation of a water-tube boiler as the only kind that can fulfill these conditions. The excellent results which have been obtained in some recent locomotives both here and abroad, by the use of water-tubes, either in the grates, in the arch, or transversely in the upper portion of the firebox, suggest that the time is ripe for building an experimental locomotive with a water-tube boiler. Such a boiler would open the way for an increase in steam pressures to 250 or even 300 pounds to the square inch. With steam supplied at such pressures we should look for the universal adoption of compound cylinders, and, in time, for the introduction of triple, and even quadruple expansion. As a concomitant of these features we shall see superheating introduced; indeed, there are locomotives on the continent of Europe that are already equipped with superheating devices that are giving excellent results. With these changes successfully worked out, there is no reason why the power of our locomotives should not be increased from 35 to 40 per cent within the next decade. There will, of course, be the problem of providing sufficient adhesion for the great cylinder power thus rendered possible; and it is likely that in spite of the great popularity of the four-coupled Atlantic type, in the most powerful express engines of the next decade we shall see a return to the six-coupled type.

NEW LONDON TELEPHONE SYSTEM.

The British Post Office has decided to adopt the toll system in connection with their new London telephone service, which will be in operation in the course of a few weeks. For this purpose a special meter has been designed. The number of the subscriber is inscribed upon the meter, and the instrument will record 10,999 messages. The machine is automatic in its action, the operator simply having to press a button at the close of each service to effect its record. The Postal Telephone Exchange is established in the building in Queen Victoria Street, hitherto utilized for the transaction of the business of the Post Office Savings Bank. It will be one of the finest and best equipped exchanges in the world when the work is complete. The Western Electric Company are fitting the exchange at a total cost of $250,000. The total capacity will be 14,400 subscribers. The telephone wires are conveyed into the exchange in 110 ducts laid in a tunnel. Each duct carries 434 wires. The ducts are paper-insulated and sheathed in lead. When they reach the sub-basement that has been provided to the exchange, the tubes decrease in diameter, silk insulation being substituted for that of cotton. The smaller tubes are employed to facilitate convenient handling on the testing frames. The exchange room is in the shape of the letter L, with the superintendent's desk placed in the center. This official can tap any operator's circuit, without the exchange operator's knowledge, and can overhear any conversations between the operator and subscriber. The arrangement will be of particular value in the investigation of complaints. The superintendent can also instantly connect the operator's apparatus with his own for the purpose of ascertaining obstructive or irregular working. The glow lamp system has been adopted. The switchboard is divided into sections with 180 subscribers to each, presided over by one operator. There are two sets of accumulators for providing the necessary current. Each set consists of eleven lead tanks, weighing two tons when filled.

THE BERLIN-ZOSSEN HIGH SPEED ELECTRIC ROAD.

A series of most important and interesting experiments in electric traction is about to be conducted on the military road between the two German cities of Berlin and Zossen by the two foremost electrical companies in Germany. The car, which has been already constructed, has attracted world-wide attention by reason of the fact that the unprecedented speed of 124 miles per hour may be reached, although the attainment of such high speed is by no means the primary purpose of the experiments.

Of the relative efficiencies of steam and electric

roads, not a little, it is true, has been written. Nevertheless, it has never been definitely determined at what speeds the electric car is more efficient than the steam locomotive. It will therefore be the object of the engineers in charge of this novel enterprise to collect such accurate data as will enable the future constructor of railways to know what are the motor-efficiencies for various speeds and for various wind-resistances, what must be the power capacity of the central station, and what is the profitable speed limit of the electric car. In the current SUPPLEMENT will be found an exhaustive article by Mr. A. Lasche on the preparations which have been made for the speed trials, and an interesting description of the car to be used.

For American engineers this investigation, which will probably be carried out with characteristic German thoroughness, will be of peculiar importance. The directors of the London Underground Road, despite American protests, have declared themselves strongly in favor of the three-phase system of electrical traction. The Berlin-Zossen road will be operated on a three-phase system, which differs only in the use of transformers on the cars from the system advocated for London. For that reason the results will be looked for with no little interest. If the truth must be told, we know but little of high-tension, polyphase railway systems in the United States. For industrial purposes, it is true, the alternating current of great voltage is now widely employed; but for electric railways we still cling to the direct-current system. The Germans and Austrians have proved, to their own satisfaction at least, that for railways of standard size the three-phase system presents immense advantages over the direct-current method. The Valtellina road, built by an Austrian firm in Italy, certainly proves that in the main the polyphase current is better than the direct current. Whether the Berlin-Zossen trials will furnish convincing proof of the greater efficiency of the three-phase system of electric traction is a question that is of more weight than may at present be appreciated. For its answer may mean the complete abandonment of a system which was invented in America, and the substitution of a distinctly European method of transmitting electrical energy for railways.

PARIS EXHIBITION OF ALCOHOL-CONSUMING DEVICES.

The enormous production of alcohol in France has led M. Jean Dupuy, Minister of Agriculture, to offer a series of prizes for any kind of apparatus or machinery that will open a way for its greater consumption. An exhibition of inventions for the use of alcohol for illuminating or heating purposes or for motor power will be given in Paris in the grand palace of the exposition, Champs Elysées, from November 16 to 24. It is proposed to apply motor power to agricultural implements, under the direction of the Department of Agriculture. The prizes awarded will consist of a series of medals.

The exhibition and experiments will be divided into three classes:

First. Stationary motors; motors for navigation; locomobiles and motors for working pumps; automobiles under 25 horse power; insulated carburetors.

Second. Incandescent lighting, divided in two classes: (1) Apparatus using pure medicated alcohol; (2) apparatus using carbureted alcohol.

Third. Heating apartments; bath houses and hothouses for flowers; chafing dishes, dish warmers, flat-iron heaters, curling irons, lamps, etc.

The minister does not state whether the citizens of other countries will be permitted to compete for the prizes, but, in any case, the presence of Americans in Paris with their apparatus for the consumption of alcohol would furnish a good opportunity for introducing their goods into the French market.

A recent law has entirely removed from wine and beer the high tax formerly levied upon those drinks when they were brought into a city. One of the means adopted to make up for the deficit caused by the abolition of the gate tax was the imposition of a tax of 220 francs ($42.46) per hectoliter (26.417 gallons) of alcohol, in place of the old tax of 56 francs ($10.80) per hectoliter. There is also an additional tax in the cities, according to their population. In Lyons it is 100 francs ($19.30) per hectoliter, making 250 francs ($48.25), which goes to the State. Besides this, there is a gate tax in Lyons of 30 francs ($5.79) per hectoliter, which goes to the municipality, making a tax of 280 francs ($54) on every hectoliter of alcohol.

It is declared that this new tax on alcohol has caused a diminution of 50 per cent in the consumption of rum, and a smaller falling off in the consumption of other alcoholic liquors. But the output of alcohol augments, and it is contended that the increased volume is the work of fraudulent producers, what we would call "moonshiners," who declare but a small part of what they produce. They are here called "boilers of growths." They have a license from the government to produce alcohol, but their production invariably exceeds the quantity reported and upon which they pay the tax. The market is in some way or other flooded with medicated and other alcohol, for all of which it is desired to find a means of consumption.

A report on this subject, presented to the French Parliament and published in the Journal Officiel two years ago, gave a tabulated statement of the quantity of alcohol produced in France and Germany in 1897. The production in France was reported to be 2,022,000 hectoliters (53,415,174 gallons) of legal alcohol. It stated that the illegal product of the boilers of growths could not even be approximated. For the year 1899, the production for all of France was 2,241,382 hectoliters (59,210,580 gallons). When I applied to the office of the internal-revenue collector, he could only give me data for the two years here mentioned. He assured me that the excess of stock consisted largely of the unreported production of the boilers of growths. Of 250 distilleries, 50 produced nearly the entire quantity reported as given above.

The production of alcohol in Germany in the year 1897 was 3,616,319 hectoliters (95,532,300 gallons), two-thirds of which was derived from potatoes of domestic origin. It was produced in country distilleries, which number about 12,500, of which 5,226 produce only from 10 to 100 hectoliters (264 to 2,642 gallons).

The report submitted to the French Parliament says that France's best customer for sugar, the United States, will soon become an exporter on account of its relation to Cuba, and it therefore urges the enactment of a law that will encourage the manufacture of alcohol as a consumer of the supposed future surplus in the beet crop. The present annual sugar product of France is 850,000 tons, of which the United States buys more than any other country. Should American purchasers fall off, the beets now worked up into sugar would go to increase the output of alcohol, for which there is now no means of consumption in sight. In connection with the projected exhibition, it is observed that alcohol enters but very little into use for lighting, while in Germany it is the great illuminant for parks and public places.

I would suggest to Americans who may attend the coming exhibition that lighting, heating, and cooking apparatus are likely to receive favorable attention here, says United States Consul John C. Covert, of Lyons, where coal is dear and oil pays a high customs duty, as well as freight over 3,000 or 4,000 miles of land and sea. It is possible that a small handy cooking apparatus, heated by alcohol, would fill a want. All over France there are thousands of people who lead an isolated existence in one room, up four or six flights of stairs, who would prepare their first meal of coffee or chocolate and their evening soup on such a contrivance. The national custom, especially among the poor and middle class, is to take these two meals in a cheap restaurant; but customs change, and the effort to introduce new uses for alcohol may be a means of breaking up this habit—above all, if it is in harmony with ideas of strict economy.

END OF THE PAN-AMERICAN.

The Pan-American Exposition ended November 2 at midnight, when President John G. Milburn pressed an electric button and the lights in the electric tower grew dim for the last time. A corps of buglers standing in the tower sounded "taps," and one of the glories of the exposition, the electrical illumination, passed away, and the exposition was ended, says The New York Times.

The exposition has not been a financial success, but the benefits derived from it will be of great value to the commercial interests of the country. The primary object of the exposition was to advance the friendly relations and commercial intercourse between the United States and the other countries of the two Americas. In this respect it has been a decided success. The republics of Central and South America, Mexico, and the Dominion of Canada responded heartily to the suggestion of an all-American exposition, and sent to Buffalo a collection of exhibits seldom if ever before equaled.

The financial loss will be in the neighborhood of $3,000,000. The statement to be issued by the officers of the exposition setting forth the expenditures and receipts will be made public some time this month.

The loss will fall upon the holders of the common stock, the holders of second mortgage bonds, and the contractors who erected the buildings. Two hundred and ten thousand shares of common stock were sold at $10 a share. The stock was subscribed for by the citizens of Buffalo and the Niagara frontier in small lots of from one share to one hundred, so that this loss of $2,100,000 will not be seriously felt. The first mortgage bonds amounting to $2,500,000 will be paid in full. An issue of $500,000 second mortgage bonds is unprovided for, but the revenue from salvage on the buildings and from other sources will probably cover a part of this indebtedness. The balance due to contractors is not definitely known, but it is said that it represents their profits for the work done and no one will be seriously embarrassed by the loss.

The total number of admissions for the six months was close to 8,000,000. The great snowstorm of last April was a severe blow to the exposition, and the formal opening of the exposition was postponed until May 20. The death of the President was another blow to the Pan-American. The attendance had been increasing steadily up to the date of the assassination of President McKinley. The gates were closed for two days, and when they reopened there was a drop of 12 per cent in the attendance and no improvement followed.

The government exhibit will be at once shipped to Charleston.

PRIZES COVERING OVER $11,000 FOR A TRACTOR FOR MILITARY PURPOSES.

It is essential that tractors for military purposes should be capable of a much greater radius of action, without the replenishment of fuel or water, than is at present obtained by any engines constructed for either military or commercial purposes. The Secretary of State for War of the British government offers three prizes for the best tractor meeting the requirements. The first prize is 1,000 pounds sterling; the second, 750 pounds sterling; and the third prize, 500 pounds. To each prize will be added a bonus of 10 pounds for every complete mile beyond the minimum of 40 miles. The total amount of this bonus shall not exceed the sum of the particular prize to which it may be added. The trials will be conducted by the War Office Committee on Mechanical Transport, and will commence in the spring of 1903, and the exact nature of the trials will be determined upon by this committee. The general scheme will be drawn up and issued to all competitors. Forms of entry will be supplied on application to the Secretary of Mechanical Transport Committee, War Office, Horse Guards, Whitehall, London, England. Those who intend to enter the competition must send in these forms to the Secretary not later than January, 1903. A full set of drawings giving dimensions and a specification giving complete details, together with a statement of the prize, must be lodged with the Secretary before the commencement of the trials. Any of the competing tractors may be purchased at the price stated by the competitor, and all designs will be considered confidential, and even the tractors which are retained by the government will not prejudice the patent rights. Full details of the qualifications may be obtained of the Secretary.

SCIENCE NOTES.

The new English coin bearing the head of King Edward VII. will shortly be ready for circulation. The designs have been prepared by Mr. G. W. De Saulles of the Royal Mint, a special audience for the accomplishment of which was granted him by the King. There will be but slight alterations from the designs on the existing Victoria coins. The Latin inscription will be the same, the name King Edward the Seventh being substituted for that of Queen Victoria, and such additions carried out as are rendered necessary by the change in the royal title recently sanctioned by Parliament. With respect to the reverse side no alteration will be made on any of the coins, with the exception of the bronze money. In this instance the familiar figure of Britannia will be displayed, but without the ship and lighthouse.

The British Association has made the following grants for scientific purposes: Mathematics and physics: Electrical standards, £40; seismological observations, £30; investigation of the upper atmosphere by means of kites, £75; magnetic observations at Falmouth, £80. Chemistry: Relation between absorption spectra and constitution of organic substances, £20; wave length tables, £5; properties of metals and alloys affected by dissolved gases, £40. Geology: Photographs of geological interest, £5; life zones in British carboniferous rocks, £10; exploration of Irish caves, £45. Zoology: Table at the Zoological Station, Naples, £100; index generum et specierum animalium, £100; migration of birds, £15; structure of coral reefs of Indian region, £50; compound Ascidians of the Clyde area, £25. Geography: Terrestrial surface waves, £15. Economic Science and Statistics: Legislation regulating women's labor, £30. Mechanical science: Small screw-gage, £20; resistance of road vehicles to traction, £50. Anthropology: Silchester excavation, £5; ethnological survey of Canada, £15; age of stone circles, £30; anthropological teaching, £3; exploration in Crete, £100; anthropometric investigations of native Egyptian soldiers, £15; excavations on the Roman site at Gelligaer, £5. Physiology: Changes in hæmoglobin, £15; work of mammalian heart under influence of drugs, £20. Botany: Investigations of the cyanophycene, £10; the respiration of plants, £15. Educational Science: Reciprocal influence of universities and schools, £5; conditions of health essential to carrying on work in schools, £2. Corresponding societies: Preparation of report, £15. Total, without grant to corresponding societies, £1,000.

Government Estimate of the Corn Crop.

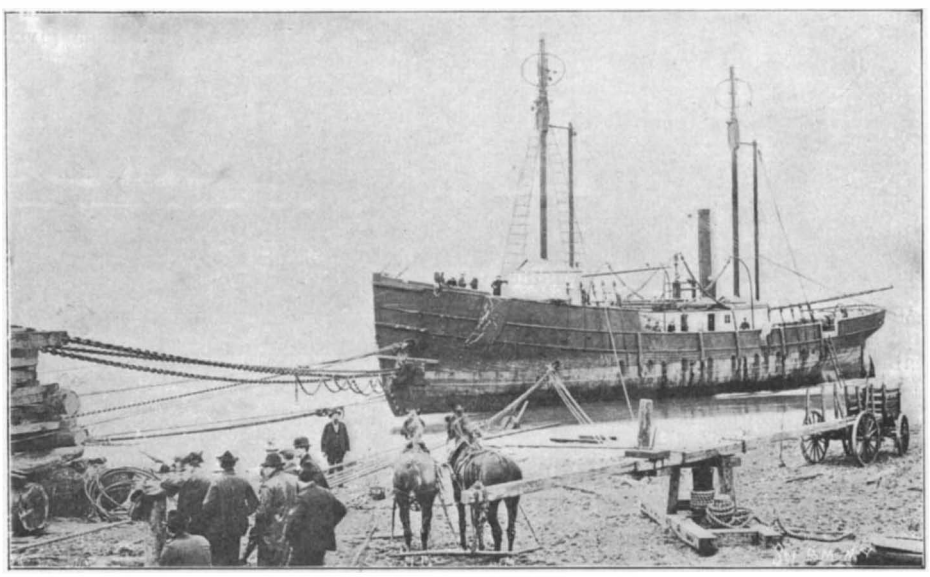
The Agricultural Department at Washington has just issued its estimate of the year's corn crop, showing a total yield for all the States of 1,250,597,000 bushels. Of this the statement shows that Nebraska, notwithstanding the dry weather which prevailed during July, will furnish 103,367,000 bushels, or more than one-tenth of the entire crop. This is interesting as showing the wonderful recuperative properties of the Nebraska soil. There is probably no other State in the Union which would, under the circumstances, make such a magnificent showing. Nebraska is a grand State and is rapidly increasing in wealth and population.

A NOVEL SALVAGE OPERATION.

BY WALDON FAWCETT.

A most noteworthy advance has been made during the past few years in the methods of conducting marine wrecking operations, and no better illustration of this could be afforded than by the recent achievement in raising the Columbia River Lightship from the sands on the beach north of Cape Hancock on the North Pacific coast, where she stranded about two years ago, and the removal of the vessel overland to the waters of Baker's Bay.

The lightship, a composite vessel which was built in 1891 and has a 12-inch steam fog-signal, broke away on November 29, 1899, from her station off the entrance to Columbia River and went ashore near McKenzie Head, Cape Disappointment, Wash., nearly eight miles distant. When the United States Lighthouse Board advertised for bids for getting the vessel off the beach a number of propositions were submitted, including one from a Portland wrecking firm, which proposed to take the vessel overland a distance of more than a third of a mile and launch her in the waters of Baker's Bay on the Columbia River. Owing



COLUMBIA RIVER LIGHTSHIP ON THE BEACH—VIEW SHOWING HAULING TACKLE AND HORSE-POWER WINCH.

to the extreme novelty of this suggestion, and considerable skepticism as to its practicability, the plan was rejected and the salvage work intrusted to wreckers who proposed to take the vessel out to sea.

After prolonged effort it was found impossible to restore the stranded ship to her native element by retracing the route which the craft had followed when coming ashore, and recourse was finally had to the ingenious plan of taking the ponderous hull overland. The difficulties of this undertaking had meanwhile, however, multiplied. Originally the ship lay head on in a position convenient for the commencement of the overland journey, but in the course of the efforts to take the vessel out to sea she was turned nearly broadside with her stern on the beach, and was in this position abandoned. It was necessary, therefore, to first raise the vessel from six or seven feet of sand surrounding her and turn her bow in the direction of the shore ere any genuine progress whatever could be made.

The methods employed were as unique and strikingly original as the general plan itself. A cribwork of logs nearly twenty feet in height was erected, and over this was passed the cables which were fastened to the bow. These chains passed over a rolling log some two and a half feet in diameter on the top of the cribwork. This was done in order to secure a lifting pull upon the bow when the power was applied. In this manner the stranded vessel was dragged a distance of more than forty yards, the bow thus being turned in the proper direction, although it was found that when the bow was finally brought to face the shore the vessel was embedded in the sands to a depth of seven feet at the bow and six feet at the stern. The turning of the vessel also sent her partially over on her beam, so that the deck was at an angle of nearly forty-five degrees.

The first task, therefore, was to straighten the vessel, and this was done by placing large logs on either side, which served as a foundation for the screws with which she was lifted into a vertical position. It was also deemed wise to put chains under the vessel at the bow and stern to still further assist in lifting her out of the sand, and this was accomplished by stretching a chain parallel with the ship on one side, leading it across the bow and attaching it to a capstan capable of pulling seventy tons. Some excavation was necessary in order to get the chain down as far as possible from the surface ere the strain was applied. With the application of the power a steel bar, some thirty feet in length and sharpened chisel-fashion at one end, was utilized to loosen the sand under the keel of the bow, in order to allow the strain to gradually draw the chain under the bow and back to the desired position.

The same method was followed at the stern, and thus the work of placing chains under the vessel was accomplished in a comparatively short time, whereas under any other form of procedure an interval of at least a month would probably have been consumed in the task. The vessel rested upon a plank cradle or sled, as it might perhaps be termed. Each chain was fastened at either end to an immense log supported by a cribbing of timber upon a plank foundation formed by material four by twelve inches in dimension and two and a half feet in thickness. Before introducing the plank foundation the wreckers attempted to use logs, and had succeeded at one time in getting the vessel raised to the desired position and in readiness to start upon the journey to the bay, when a heavy storm came up, washing from under the vessel the logs which had formed the foundation and allowing her to settle back into her former bed. Another serious inconvenience to the wreckers arose from the fact that much of the sand around the ship was of the nature of quicksand, and when stirred or walked over to any considerable extent became soft and springy, so that during a large portion of the time the men were compelled to work knee-deep in sand and water.

By using screws upon what might be called the temporary platform previously mentioned the wreckers were finally enabled to lift the lightship out of the sands to a height of twelve or thirteen feet and to place under the hull a permanent cradle made of timbers. The formation of this vehicle, in which the ship was to make the journey to her natural element, is of interest. Two timbers, each twenty-five feet in length by twelve by twenty-four inches, were placed under the bow, transversely to the length of the ship and nine feet apart. A similar arrangement was carried out at the stern. On top of these other timbers were laid, extending from the keel and higher up from the side of the vessel, out to substantially the end of the first-mentioned long timbers. These timbers, in turn, were connected by other timbers running parallel with the ship; and under the ends of the long timbers projecting from the sides of the ship were placed oak shoes, two under the end of each timber, some four feet apart, which shoes in turn, when the vessel was lowered ready for pulling, rested upon oak rollers, which, in turn, rested upon a plank track.

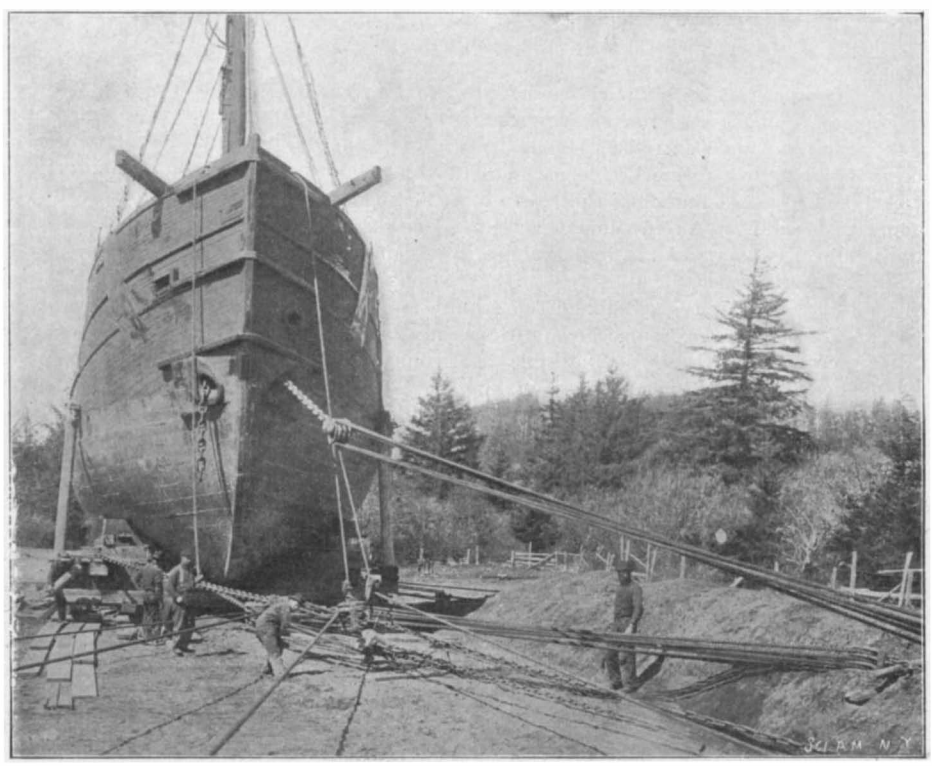
By this arrangement the ship was given four bearings, and it was made possible to haul the craft over an uneven surface and along a crooked route. Heavy cables were put around the vessel's stern, extending

THE ROLLER WAYS ON WHICH THE LIGHTSHIP WAS MOVED.

along her side and through the hawse pipes, and to these were attached the tackle blocks, to which power was applied by means of a capstan operated by horses. In this manner the ship was taken up the beach, over the uneven ground of a peninsula, across a swamp, and finally down a grade to the beach of Baker's Bay. The rate of progress averaged about one hundred and seventy-five feet a day, and the altitude at the highest point traversed is in the neighborhood of thirty-five feet.

Repairs were made upon the vessel at the end of the overland journey, and she was launched in the waters of Baker's Bay upon rollers in the same manner that she crossed the peninsula. This method was adopted by reason of the fact that the water in the bay is shallow for a long distance out from shore, and it was thought that were the craft launched from the usual type of ways, such as are utilized for the first launching of ships, she would be pretty certain to become firmly lodged in the mud, even were the operation conducted at high tide. By the plan adopted she was taken out to a sufficient depth of water to float her without either difficulty or danger.

The foundations of the large extension to the Victoria and Albert Museum, South Kensington, London, have been completed and the work of construction is now being rapidly proceeded with. It is estimated that the building will not be completed for another four years. The late Queen Victoria laid the foundation stone in 1899. The new wing will considerably relieve the cramped condition of the exhibits in the main building. While digging deeply for the foundation of the central tower, a stone of the glacial epoch was discovered, together with a valued assortment of fossil bones, including those of an extinct species of ox, and a fragment of an elephant skeleton. These are all carefully preserved in the Natural History Museum.



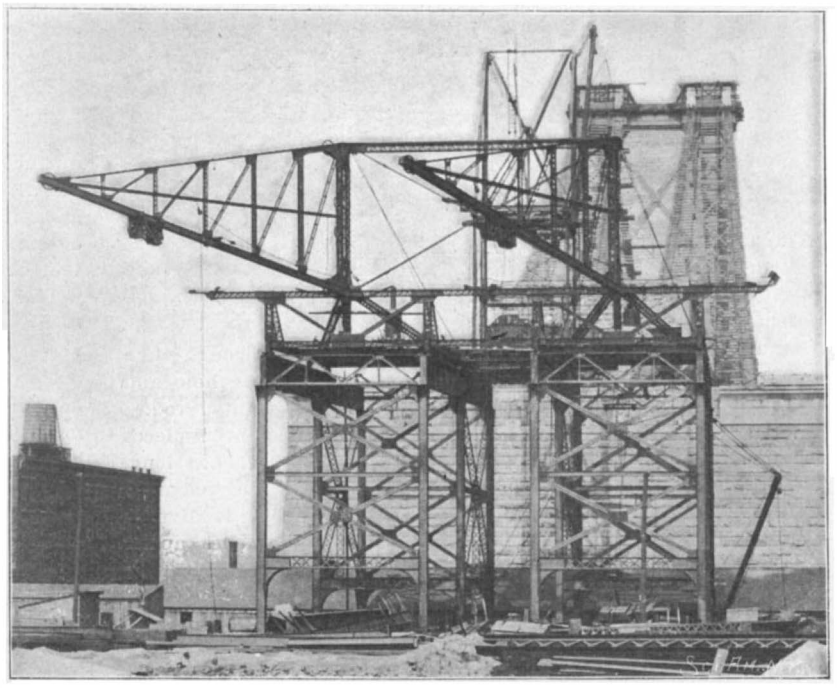
BOW VIEW, SHOWING ROLLER WAYS AND HAULING TACKLE.

BUILDING THE APPROACHES OF THE NEW EAST RIVER BRIDGE.

The towers, cables and suspended roadway of the new East River Bridge are, of course, the most important part of that structure, and by virtue of their conspicuous position, are just now the most in the public eye; and yet it is a fact that, of the great elevated highway connecting Brooklyn with Manhattan, the portion which spans the East River is rivaled in extent and in the weight of materials that enter into it by the two great approaches by which the roadway is carried up from the street grade to the level of the tops of the anchorages. The approach on the New York side is 2,500 feet long, and calls for the delivery of no less than 12,000 tons of steel for its construction. The Brooklyn approach is 1,744 feet long, and the material in it will weigh 6,000 tons. Each of these structures would in itself be a notable work among the great bridge structures of the world, were they not eclipsed by the more daring and difficult suspended structure across the river.

On each side the approach consists of a massive viaduct 114 feet in width over all, with provision for travel on three separate decks or platforms. The lowest deck will carry the street railway tracks, of which there are four. This structure is carried upon four longitudinal rows of massive latticed columns, which are spaced 60 feet apart longitudinally. Every alternate pair of columns is braced to form an open tower construction. Upon the caps of the columns are four longitudinal lines of 62½-foot plate girders, and above the plate girders are placed the transverse floor-beams, which carry the street cars. These floor-beams are carried out beyond the columns to a distance of 13½ feet in the form of cantilever projections, which serve to carry the floor of the two roadways. Above the two inside lines of the girders above referred to, is constructed another viaduct with its columns spaced 22 feet 10 inches apart longitudinally, and above these columns are placed the floor-beams which carry the double-track elevated railway. This elevated railroad structure commences at the inshore end of the anchorages and descends on an easier grade than the platform for the street railway cars, which will have to be brought gradually down to the street surface on a three per cent grade. The elevated structure descends until it is at the proper elevation to connect with the elevated systems in Brooklyn and New York. Immediately below the elevated viaduct flooring, the supporting columns are strongly sway-braced, and beneath the sway-bracing is a platform for bicycles, the footwalks being carried at the level of the street-car tracks.

Our photograph shows an ingenious design of traveler by which the main portion of the viaduct up to the level of the street-car tracks is being erected. This traveler is seen in the foreground of the illustration with its two booms swung out over the adjoining foundations. Behind these, and standing upon the two interior lines of the columns, is a square timber tower which forms part of the derrick for erecting the elevated structure, this portion of the viaduct being built as the lower story is completed. The first traveler is a massive affair, weighing 70 tons. Its overhang is sufficient to enable it comfortably to cover one panel or 62½ feet of the viaduct. Its floor platform is 60 feet in length by 87 feet wide. At the front of the platform is a transverse riveted truss 10 feet in depth, and above this truss, at two of the panel points, rise the two extensions of the vertical posts which form the masts for two triangular booms, each 75 feet long and 30 feet in depth at the masts. The masts are tied together at the top by a horizontal latticed strut, and the top of each mast is also guyed back to the longitudinal sills of the traveler platform. The whole traveler is carried on a dozen double-flanged wheels, three beneath each longitudinal member of the platform. When the traveler is in operation, it is wedged up clear of the forward wheels, and the front transverse girder is thus given a solid bearing upon the completed portion of the viaduct. Each of the booms can swing through an arc of 180 deg. and upon the lower flange of each is a trolley which is capable of lifting a 20-ton load. With this traveler, the heavy material of the viaduct, including the longitudinal plate-girders and floor-beams, can be expeditiously lifted and swung into position, ready to be bolted up for the riveters.



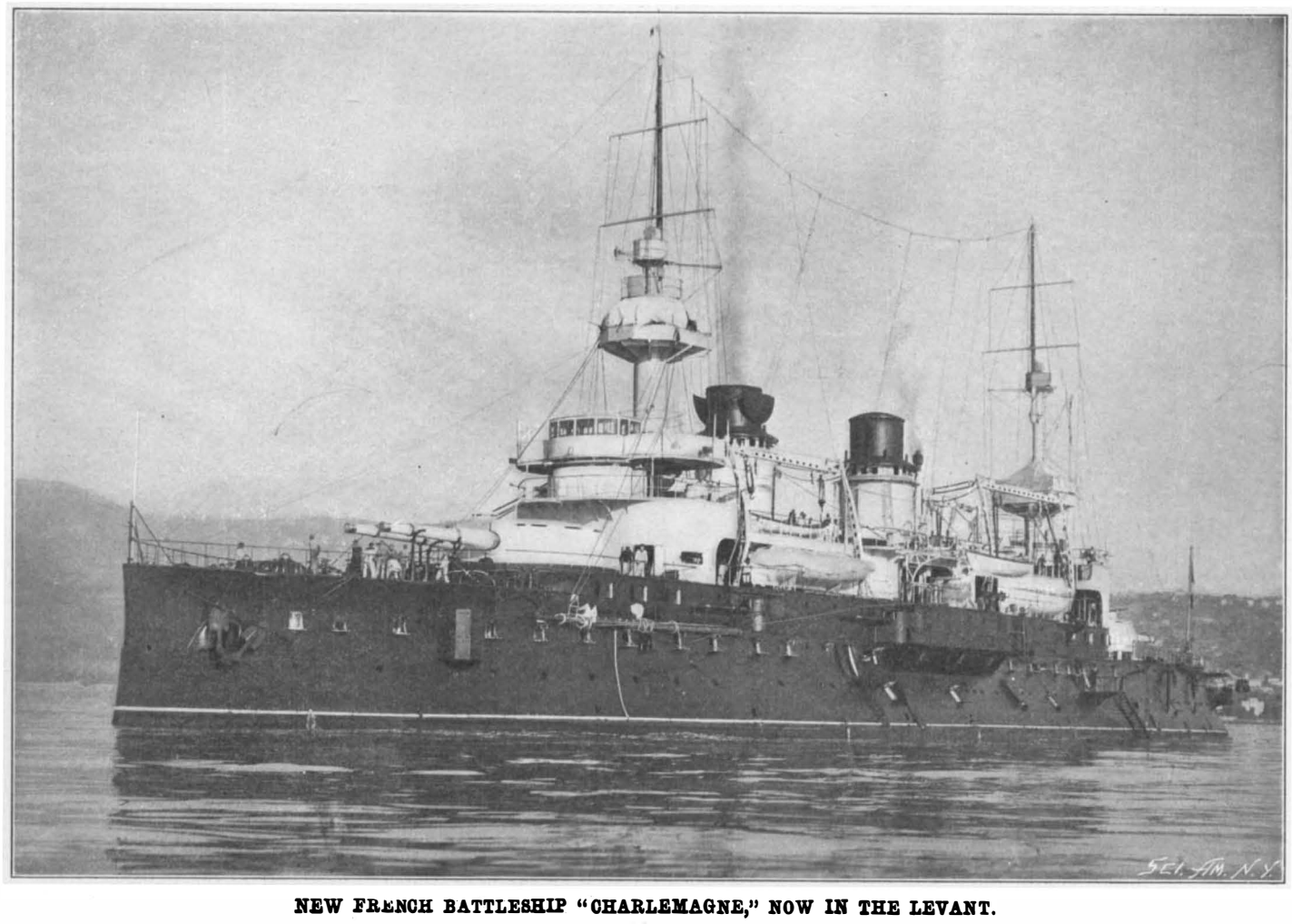
SEVENTY-TON TRAVELER ERECTING THE BROOKLYN APPROACH TO THE NEW EAST RIVER BRIDGE.

The rear traveler which, as we have shown, follows along behind the front traveler as the first story of the viaduct is completed, consists of a tower 40 feet high with two boom derricks at the top, each of which swings a 54-foot boom. With this plant the bridge erecters are making good progress, and the indications are that the approaches will be complete by the time the great suspended span is ready for opening.

FRENCH FIRST-CLASS BATTLESHIP "CHARLEMAGNE"

Among the powerful ships of the French Mediterranean fleet which has gathered in the Levant to enforce the demands of the Republic upon the Sultan of Turkey, the latest and most powerful are the three identical first-class battleships "Gaulois," "Charlemagne" and "St. Louis." The "Charlemagne," which was launched in 1895, embodies several features which, while they have appeared in earlier vessels of other navies, are new in the French navy. The most novel of these is the method of mounting the main battery. In the battleships of the "Carnot" and "Charles Martel" type, which immediately preceded the "Charlemagne," the four heavy guns of the main battery are carried in four separate turrets, on what is known as the quadrilateral plan, two of them being carried on the center line, one forward and one aft, and one on either beam amidships. This was a popular arrangement in vessels built during the eighties, and though it was abandoned in other navies, it has remained longer in favor among the French. In the "Charlemagne," "St. Louis" and "Gaulois," the main battery has been placed in two main positions, one forward and one aft, as in our own "Kentucky" and "Alabama," and the secondary battery has been gathered within a central citadel which is covered with a complete wall of vertical armor. By making this change France has at last fallen in line with the other nations, and adopted a plan which seems likely to be permanent. The "Charlemagne" has a displacement of 11,275 tons on a maximum draft of 27 feet 6 inches. She is characterized by a lofty freeboard and her midship section shows the curious "tumble-home" (a survival of the days of the wooden three-decker), of which we have a solitary example in our own navy in the "Brooklyn." The tumble-home sides allow a concentration of fire parallel with the keel of the ship, and it has the further advantage of bringing the weights well inboard, and thereby contributing to stability. It has a serious drawback, however, in the fact that the living quarters of the crew are considerably curtailed.

The protection of the hull of the "Charlemagne" embodies some novel structural features. Immediately at the water-line is a continuous belt, which is 6 feet 6 inches in depth, and tapers from a maximum thickness of 15¾ inches amidships to 3 inches at stem and stern. Above this belt is another which is 3 feet in depth, and 3 inches in thickness. Immediately at the top of the main belt is a 3½-inch armored deck, and at the bottom of the belt, below the water-line, is an armored deck which is 1½ inches in thickness. From the top of the 3-inch belt up to the level of the main deck, there is no armor protection, except around the ammunition hoists leading to the 12-inch guns. The secondary battery, which is located within the superstructure amidship, is protected by 3 inches of armor, while the 12-inch guns are protected within turrets of 15¾-inch armor. The obviously weak point in the armor plan is the unprotected space between the main deck and the armored deck, for it would be possible for an enemy to send high-explosive shells through the sides of the vessel and explode them immediately beneath the guns of the secondary battery. The damage wrought by such shells in the recent trials of the "Belleisle" show that a few well-placed shells of this character



NEW FRENCH BATTLESHIP "CHARLEMAGNE," NOW IN THE LEVANT.

Displacement, 11,275 tons. **Speed,** 18.1 knots. **Maximum Coal Supply,** 1,100 tons. **Armor:** Belt, 15¾ inches; gun positions, 15¾ inches; deck, 3½ inches. **Armament:** Four 12-inch, ten 5.5-inch rapid-fire, eight 4-inch rapid-fire, sixteen 3-pounders, 18 smaller guns. **Torpedo tubes,** 4. **Complement,** 681. **Date,** 1900.

would be sufficient to put the secondary battery entirely out of action.

The 12-inch guns, which weigh 46 tons apiece, are of a modern and very powerful type, although they are not equal to the new 40-caliber 12-inch guns now building for the United States navy. They fire a 644-pound projectile with a muzzle velocity of 2,625 foot-seconds, and a muzzle energy of 30,750 foot-tons, the muzzle penetration being 37.3 inches of iron. The United States navy 12-inch gun fires an 850-pound projectile with a muzzle velocity and energy of 2,854 foot-seconds and 47,994 foot-tons, and it has the added advantage that, owing to the greater weight of the projectile, the velocity and energy will not fall off nearly so rapidly as they will in the case of the lighter 644-pound projectile of the French gun. The secondary battery of the "Charlemagne" consists of ten 5.5-inch rapid-fire guns which are contained, five of them within the central citadel on the main deck, and five of them behind shields which are mounted in broadside in the open on the superstructure deck. These guns are light as compared with the 6-inch guns which obtain favor in our own and the British navy. They fire a 66-pound projectile with a velocity of 2,625 foot-seconds, and an energy of 3,100 foot-tons. Our 50-caliber 6-inch gun, on the other hand, sixteen of which will be found in the secondary battery of the battleship "Maine" fires 100-pound projectiles with an initial velocity of 3,000 foot-seconds and an initial energy of 6,240 foot-tons. The comparative lightness of the secondary battery of the "Charlemagne" is, however, somewhat compensated for by a battery of eight 4-inch rapid-fire guns, which is carried on the bridges and superstructure at a height of 35 to 40 feet above the water line. There are also sixteen 3-pounders, ten 1-pounders and eight machine guns. The "Charlemagne" is driven by engines of 14,500 indicated horse power, which gave her on her official trial a speed of 18.1 knots per hour. She can carry a maximum coal supply of 1,100 tons, which is small compared with that of our battleships, and she has a complement of officers and men of 631. She has four torpedo-tube discharges, of which two are submerged.

Efforts to Save the Gutta-Percha Tree.

The scientists in France are now engaged upon the problem of acclimatizing the *Isonandra gutta*, the tree which produces gutta-percha, indispensable to the construction of submarine cables.

It seems that no other product known at present replaces the gutta-percha found in the forests of the Malay Peninsula and in certain districts in Malacca. Inferior qualities have not the requisite durability for submarine use.

The plantations in the above-mentioned districts have been so ruinously exploited by the natives, who uproot full-grown trees and cut young plants before they come to maturity, that it is feared there will be a shortage in the supply of this quality of gutta-percha in the course of fifteen years, unless means are taken to protect the forests or to propagate the plants elsewhere.

The following figures will give some idea of the rapid increase in the export of the gum: In 1845, Europe imported only 9,000 kilogrammes (19,841 pounds) of gutta-percha; in 1857, when the Singapore supply was exhausted, the Malay Archipelago exported more than 240,000 kilogrammes (529,104 pounds); in 1879, Sumatran exportations exceeded 135,000 kilogrammes (299,621 pounds), and Borneo exported 1,300,000 kilogrammes (2,863,900 pounds). In order to attain these figures, it is estimated that the natives must have sacrificed more than 5,000,000 trees.

Expeditions sent out by France, England and Holland to discover the botanical origin of the precious gum and to increase its production, have reached the same conclusion. As it is almost impossible to find a full-grown gutta-percha-producing tree, the situation will be extremely grave if urgent measures are not taken.

The British government has posted placards for the protection of the trees, with no effect. Holland has planted trees, but in insufficient number and of inferior species.

Productive species have, however, been found in the Malay forests extending between the rivers of Pahang, Patani, and Perat. They have been transplanted into Reunion and Madagascar, and if they thrive there will be less danger of a dearth in the supply of gum required for submarine cables.

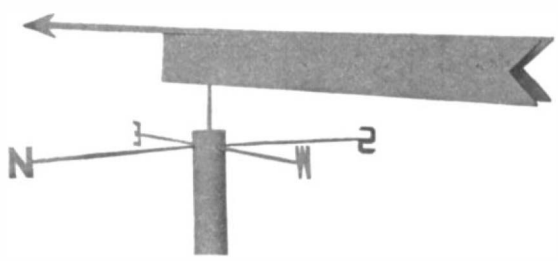
The employment of automobiles by the German army during the recent maneuvers proved a conspicuous success. Seventeen motor cars of various designs were requisitioned, and the military authorities intend to favor their more extensive utilization for the generals in command and their aides-de-camps. The steam lorries used for the transportation of ammunition and the commisariat did not prove so satisfactory, but this is probably due to the bad state of the roads and the unusually severe tests to which they were submitted.

A FEW METEOROLOGICAL INSTRUMENTS.

BY GEORGE M. HOPKINS.

In previous articles of this series a few meteorological instruments of simple construction have been illustrated and described, but the collection would be incomplete without a weather vane, a wind pressure gage, and a rain gage. These instruments do not possess a great deal of novelty, but they are of considerable importance to the amateur observer.

The weather vane hardly needs explanation to make it understood. In the top of a stout pole is inserted

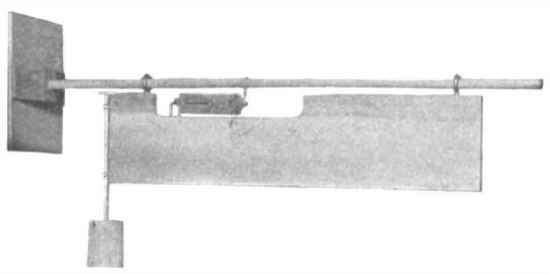


WEATHER VANE.

a ¼-inch rod which is bluntly pointed at its upper end. On this is placed a vane consisting of a wedge-shaped piece of hardwood with a hole through it, a piece of hoop iron being fastened over the hole and resting on the upper end of the blunt-pointed rod.

To opposite sides of the wedge are secured pieces of ¼-inch board 4 inches wide and 20 inches long. These pieces are let into the faces of the wedge so as to form continuous surfaces. The boards diverge so that their free ends are about 2½ inches apart. This construction insures steadiness.

The thin end of the wedge has an arrow-headed arm projecting from it to indicate the direction of the wind. In the sides of the pole, near the upper end, are inserted four ¼-inch rods arranged at 90 deg. with each other, and in slots sawed in the ends of the rods are riveted letters which indicate the points of

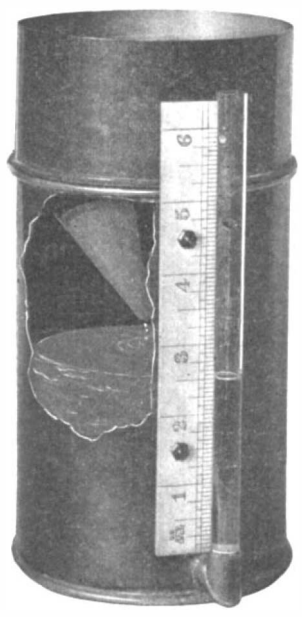


WIND PRESSURE GAGE.

compass, N., S., E. and W. These, in connection with the arrow-headed arm, enable the observer to tell which way the wind blows.

When we find the weather vane pointing toward the west we look for clear weather, and as a rule we are not disappointed; but when the vane indicates that the wind is blowing from the east, a storm is expected. When it blows from the north, cool weather may be looked for; and when it blows from the south, it hardly ever fails to bring sultry days in summer and thaws in winter.

The construction of a wind pressure gage is as simple as that of the ordinary windmill, which every boy knows how to make. A wind vane 6 inches wide and 24 inches long is made of a ⅞-inch board, on the edge of which is secured a piece of band iron which projects over the end of the board about 1½ inches. In the end of the board are inserted two screw-eyes for receiving the rod upon which the vane swings. The upper end of the rod is pointed bluntly, so that the piece of band iron which rests upon it allows the vane to swing freely in any direction.



RAIN GAGE.

The middle portion of the board is cut away from the upper edge to admit of placing a spring scale for the measurement of the wind pressure. In the upper edge of the board at opposite ends of the scale-notch are inserted wire screw-eyes to receive the horizontal wooden rod which carries the wind-pressure board, 8 by 9 inches long and ¼ inch thick.

The board is stiffened by a cleat on the back, which is bored to receive the rod. A screw hook is inserted in the rod, and another is inserted in the upper edge of the vane for receiving, respectively, the eye and hook of the scale. The spring scale is adjusted so as to hold the thin board a little more than the length of the slot in the spring-scale away from the pivot of the vane when the wind is light or nil. When the wind blows the vane keeps the instrument headed toward the wind, and the scale indicates the pressure on a half square foot, so that the reading must be multiplied by 2 to secure a correct pressure.

The rod should be inserted in a rigid post and must be exactly vertical.

When the wind blows strong from any direction curiosity is aroused as to the pressure it is exerting. This may be ascertained by observing the wind pressure gage; 1⅛ pounds pressure shows that the wind is blowing 15 miles per hour; 4½ pounds pressure per square foot represents a velocity of 30 miles per hour; 18 pounds pressure indicates a velocity of 60 miles an hour; and 50 pounds pressure is registered during a tornado and shows a speed of 100 miles an hour. In calculating the pressure as indicated by this gage it must be remembered that the board which offers resistance to the wind has only a half square foot area.

The amount of rain falling in a given time can be ascertained approximately by placing any kind of vessel having parallel sides out of doors in an open place where it may receive all the rain, and then measuring the depth of the water after the rain by means of a small stick plunged into it; the depth being registered by the wet portion of the stick. This method, however, is crude and open to objections; some of the water will spatter over, some will be lost by evaporation, and some will be displaced by the stick.

If the observer is really in earnest he should make, or have made, a copper vessel like the one shown in the illustration. It is 4 inches in diameter and 6 inches high, with the bottom set in 1 inch so as to receive the copper tube, which is bent twice at right angles, with its inner end inserted in the recessed bottom and its outer end extended up outside the vessel, and even with the bottom to receive a ⅜-inch glass tube, which is cemented therein with a cement consisting of white lead paint and litharge formed into a soft putty.

The glass tube is 7 inches long, and furnishes a ready means of ascertaining the depth of water in the vessel when viewed in connection with the scale of inches attached to the vessel.

In the top of the vessel is inserted a funnel 3½ inches long, with a cylindrical portion at the top 2 inches deep. The upper and lower edges of the main vessel are wired to give them rigidity, but the cylindrical top of the funnel is not wired.

A rubber band may be stretched around the funnel at the junction of the cylindrical and conical portions to prevent waste by evaporation at this point. To insure accuracy the copper pipe which holds the glass tube should be filled with water before the observation begins.

When the gage is used in a windy place it should be clamped to some fixed object by three screws engaging the wire rim at the bottom of the vessel.

Successful Balloon Trip Across the Channel.

M. Georges Latruffe has lately made a balloon trip across the Channel, starting from Dunkerque, on the 22d of September. After a six hours' voyage, the aeronaut, who was mounted on a balloon of 1,000 cubic yards, succeeded in making a landing on the English coast at Southminster without accident. The trip was accomplished safely, but not without some difficulty. During the voyage the balloon was carried by an east wind which took it as far as Clayton. Then it encountered a northwest wind which brought it to the mouth of the Thames, where the landing took place. The distance in a straight line from Dunkerque to Clayton is 105 miles, and if the distance from Clayton to the landing point is added, this makes a total voyage of over 150 miles. Again, the distance in a straight line from starting to landing points is 90 miles. The French aeronauts have crossed the Channel on several occasions, but the successful attempts have been rare, on the whole. The first trial was made in 1785 with a Montgolfier constructed by Pilatre de Rozier, but he lost his life in the attempt. François l'Hoste tried to cross in 1883, and succeeded only after a number of unsuccessful attempts, in which he was picked up in the sea by boatmen. A monument has been erected at Boulogne-sur-Mer to commemorate this first crossing, on the 9th of September, 1883. L'Hoste crossed again from Boulogne during the following year, and in July, 1886, crossed a third time from Cherbourg, with Joseph Mangot. His balloon was provided on this trip with sails, guide-ropes, floaters and a cone-anchor for slackening the speed. The descent took place near London, where the aeronauts were received by Mr. Lefebre, president of the Balloon Society. It was also in 1886 that M. Henri Herné made his successful trip from Boulogne to Yarmouth, and demonstrated the value of his steering and floating apparatus.

WORK ON THE SIMPLON TUNNEL.

The road from Paris to Milan by way of the Mont Cenis tunnel is 1,058 kilometers, and by way of the St. Gothard tunnel 1,068 kilometers in length. To reduce this distance to 979 kilometers is the primary purpose of the Simplon tunnel.

The new tunnel through the Simplon Pass, when completed, will undoubtedly be the most stupendous engineering feat of its kind ever performed—a feat which many engineers thought it impossible to accomplish by reason of the great depth which was to be attained.

It is evident even to a layman that it is far easier to carry a load up a hill for a distance of 500 yards than for 1,000 yards. It is this lightening of the task to be performed by the railroad locomotive which will be one of the ends attained by the new tunnel in comparison with the routes of St. Gothard and Mont Cenis. The highest point of the Simplon tunnel is 705 meters; of the St. Gothard, 1,154 meters, and of the Mont Cenis as much as 1,294 meters. The greater the height, the more formidable the difficulties. In winter time especially the operation of Alpine roads is a herculean task and involves appalling additional expenses. With the completion of the new road these difficulties will vanish. Indeed, there is probably no part of the Alps more admirably situated for railway purposes than the Simplon Pass. The construction of the St. Gothard route necessitated the building of approaches of magnificent proportions, the cost of which rivaled that of the tunnel itself. The builders of the Simplon will be confronted by no such necessity. On the northern side the new tunnel starts at the level of the valley, and on the southern side terminates after a few miles at the very border of the great plain of Lombardy.

So rapid and so fast have been the strides made by the modern engineer that this latest engineering work will be completed in a far shorter time than any of its predecessors, despite the character of the country. The building of the Mont Cenis road required thirteen years; the St. Gothard tunnel was completed only after seven and a half years; but the engineers of the Simplon have pledged themselves to finish the tunnel through the pass in five and a half years; which, in comparison with the St. Gothard, represents a reduction in cost of 25 per cent. Despite the greater rapidity with which the work can be pushed forward, and the consequent saving in expense, the tunnel will cost $55,500,000.

Keenly appreciating the difficulties which confronted the engineers of the St. Gothard and Mont Cenis routes, so far as the provision of proper ventilation was concerned, the Simplon engineers have hit upon a simple and ingenious method of improving the sanitary conditions within the tunnel. Instead of constructing a single two-track tunnel, it was decided to build two single-track tunnels, one of which was to serve, when completed, as a huge ventilating tube for the other, still incompleted tunnel. How enormously this simple expedient has improved the ventilation is shown by a comparison with the conditions that prevailed in the St. Gothard tunnel. The quantity of fresh air which could be supplied to the workmen of the St. Gothard tunnel was 1½ to 2 cubic meters per second; in the Simplon tunnel the laborers are supplied with 25 cubic meters. Moreover, by the use of sprayers the temperature has been so far reduced that the thermometers in the cuts have never registered more than 32 deg. C.—the maximum temperature attained at the St. Gothard. This result is all the more gratifying when it is considered that many skeptical engineers had declared that a minimum temperature of 40 deg. C. would be met. Disastrous epidemics occurred only too frequently among the laborers of the St. Gothard. In carrying on the work of the Simplon comparatively few men have reported themselves ill. The astonishingly small sick list may also be partially attributed to the admirable provisions made by the company in charge of the work, by securing the very best sanitary conditions. The tunnel exits consist of covered passageways through which the laborers pass into large bathrooms where they wash themselves and change their clothes.

After long diplomatic negotiations between Italy and Switzerland, work was at last begun in the autumn of 1898. Before the final permission to break ground had been received, elaborate preparations had been made for pushing on the work as fast as possible. Above all it was necessary to provide sufficient power. On each side of the mountain about 2,000 horse power was available, and this was to be used primarily to drive the ventilating apparatus and hydraulic compressors as well as workshop tools and dynamos. In the north, water power is obtained from the river Rhone: in the south from the Diveria. Through huge flumes, over 1½ meters in diameter, the water is led many miles from its source to the power house. Great repair shops were built, in which many hundred artisans were to be employed whose duty it was merely to make and repair the tools and rock drills. That so huge an undertaking should necessitate the installation of many small plants is easily understood.

From the latest reports which have been received, it would seem that about a half of the work has been completed; and if unforeseen hindrances are not encountered, the tunnel will be open for traffic before the contracted time of five and a half years. If such be the case, the engineers will receive a bounty of 5,000 francs for each day between the actual day of completion and the contracted day; for each day required in excess of the contracted time, a fine of 5,000 francs is imposed.

On the south side, the rock up to the 3,820th kilometer had been found perfectly dry; but when the 3,825th kilometer had been reached, springs yielding four to five liters of water per second were found. The schist forming the walls of the galleries was moist without, however, causing any inconvenience. But when the 3,900th kilometer was reached, more formidable springs yielding as much as 160 liters per second were discovered, the temperature of which, strange to say, varied from 25 to 30 deg. C.

During the early stages, work progressed but slowly, particularly on the south side, where the rock was exceptionally hard. How difficult was the removal of the rock on the south side may be inferred from the fact that daily progress on the north side is about 6 meters and on the south side 5 meters. This daily progress is the result of three attacks—drilling, blasting and removing the rock. The three attacks require from 6½ to 7½ hours. On the north side 7 to 8 drill holes, on the south side 11 to 12 are necessary. On the north side drills are sunk to the depth of 1.8 to 2 meters; on the south side the depth attained is only 1.2 to 1.4 meters. To blast one cubic meter of rock on the north side, 4 kilogrammes of dynamite are required. On the south side 5 kilogrammes are necessary. It is, therefore, not to be wondered at that the consumption of dynamite for a month amounts to from 13,000 to 15,000 kilogrammes (28,600 to 33,000 pounds).

The geological formations proceeding from south to north along the line of the tunnel are as follows: Calcareous mica schist and Antigoria gneiss, 6,330 meters; Teggialo lime, calcareous mica schist, mica schist and gneiss, Valle limestone, 9,700 meters; mica and gypsum on the Rhone banks, 3,700 meters. The entire tunnel length will be 19,730 meters. The rock drills used were invented by Mr. Brandt, one of the engineers. Depending upon the hardness of the rock, the water pressure on the north side at the drills varies from 60 to 70 atmospheres, on the south side from 90 to 100 atmospheres. The rapid daily progress is to be entirely attributed to the efficiency of these drills.

The laborers are almost without exception Italians, recruited from all parts of the Apennine Peninsula, from Lombardy to Sicily. The northern Italian, more industrious and more accustomed to hard work, is preferred; for the southern men, when winter comes, throw down their tools and return to their homes in the South. But despite this winter desertion, ten men are always ready to fill a place which has become vacant. Many of the laborers bring with them their wives and children. Thus it happens that on each mountainside whole villages have sprung up almost in a single night. At the present time about 2,000 laborers are employed. They have all the virtues and all the vices of the southern European. Industrious enough on the whole, sober and frugal, they are, however, easily excited. Every laborer is considered something of a disguised revolutionist, although he may have no clear idea of the meaning of socialism and anarchy. It cannot be denied that these Italian workmen are exceedingly susceptible to the fiery speeches of their countrymen. They will blindly follow their leaders without knowing whither. Strikes occur apparently for no cause. The men are ordered to lay down their tools. They obey. But it always happens that after a few days of idleness the men all return to their work under the old conditions.

An English bridge builder with experience of life in India, gives an interesting account of the wages of coolie and other caste men who have to be drawn upon for a working force in riveting, skilled workmen being very scarce. It appears that all sorts and conditions of men are impressed into the work, without consideration of their previous occupations. Whereas a blacksmith is always a blacksmith in India, and the man born to a carpenter-father follows the trade of his parent, in riveting any caste may be drawn upon. Accordingly there are sometimes milkmen, butlers, gardeners, and even outcasts impressed into closing the rivets in the several members of bridges, but the English bridge builder aforementioned says that very drastic methods are practised to make capable workmen out of the material at hand. The pay for the head riveter is about 30 cents a day; for the holder-on, 16 cents. They drive 100 1-inch rivets a day, seven days in the week, with no extra pay for Sunday, and often they are on scaffolds 200 feet from the ground, in a temperature of 115 in the shade; in the sun it is so hot that a man cannot hold his hand on the iron.

Engineering Notes.

Another new line is to unite the cities of Poltava and Yekaterinoslav, Russia. This road will be 106 kilometers (66 miles) long. The concession is for eighty-one years, but after twenty years the government is to have the right to buy the road for a stipulated price. The necessity for this line is fully appreciated by the Russian railroad building commission.

In order to combat the smoke nuisance, the Prussian government called together a committee for the trial of all smoke-consuming apparatus, says The Engineer. This committee has finished its work, and common measures are about to be taken to remove the evil. It was proposed to institute schools where stokers could be specially trained for the handling of steam boiler plants. The Steam Boiler Revision Association consulted most of the branch associations, and the result was that most of them were against the idea of the schools; but it was proposed to send properly qualified men to instruct the stokers employed in the various steam plants.

An artesian well in Grenelle, France, took ten years of continuous work before water was struck, at a depth of 1,780 feet. At 1,259 feet over 200 feet of the boring rod broke and fell into the well, and it was fifteen months before it was recovered. A flow of 900,000 gallons per day is obtained from it, the bore being 8 inches. At Passy, France, there is another artesian well 1,913 feet in depth, and 27½ inches diameter, which discharges an uninterrupted supply of 5,500,000 gallons per day; it cost $200,000. An artesian well at Butte-aux-Cailles, France, is 2,900 feet in depth, and 47 inches diameter. These are all surpassed by an artesian well in Australia, which is 5,000 feet in depth.

An elephant-catcher rather than a cow-catcher seems to be needed in India. On the railroad between Bengal and Assam, according to the Railroad Gazette, as the superintendent of the line was making an inspection trip, while passing through the great Nambar forest, the train came to a stop with a jolt that threw the travelers out of their berths. The train had run into a herd of wild elephants which were trotting down the track, the last of which had both hind legs broken and was thrown into the ditch, while the engineer counted seven others which got away. This is not the first time that wild elephants have got on the track, and ordinary fences and cattle-guards are no protection.

A locomotive boiler explosion in England is attracting much attention among engineers, by reason of the circumstances attending it. The use of copper for fire-boxes is universal there, and recently an alloy of copper and another metal has been used for stays and stay-bolts. The exploded boiler was nearly new, and had been just overhauled, nevertheless the fire-box collapsed on one side near the bottom by the failure of the stay-bolts, and threw the boiler 174 feet into an adjoining field. An examination into the probable cause of the disaster revealed that the over-heating of the composition stay-bolts by an assumed shortness of water reduced the factor of safety to about 1.38, which did not take into consideration the transverse strains to which the bolts were exposed. It is asserted that at a black-hot temperature such alloys are reduced 50 per cent in strength, and are manifestly unfit for such duty. It is said that the railway company has forty boilers fitted with these stays, but none of them have given any trouble before.

Reports of English railways for the first half of the current year are very discouraging to the stockholders, and they are hunting around, trying to find some one to make the directors of the railways do something to improve the status. The losses were chiefly in carrying freight, for the passenger traffic showed a good margin of profit, and the directors have a scapegoat in the increased cost of coal which they work for all it is worth, and a little more. In this emergency—the loss of profits—the directors are scanning the foreign horizon with the expectation of discovering better methods of handling freight, so as to decrease the cost of that detail, for it is one of the principal sources of loss. It appears that British railways are really express companies, in so far as freight is concerned, for it is asserted that merchants insist upon the delivery of goods the next day after they are ordered, whether large or small lots, and regardless of the amount of traffic there may be to any given locality. As a consequence the railways are put to great expense, which could be avoided if the time for delivery was not so short, for a few hundred pounds of freight have to be carried in a car and delivered at some country town, possibly a long distance off. Sometimes, indeed, it has to be reshipped at certain points, all of which is an added tax to the railway. In brief, the railway freight of Britain consists to some extent of small packages carried short distances, and is necessarily more costly to conduct than in this country, where the reverse is the case, so comparisons of relative cost here and abroad are out of order.

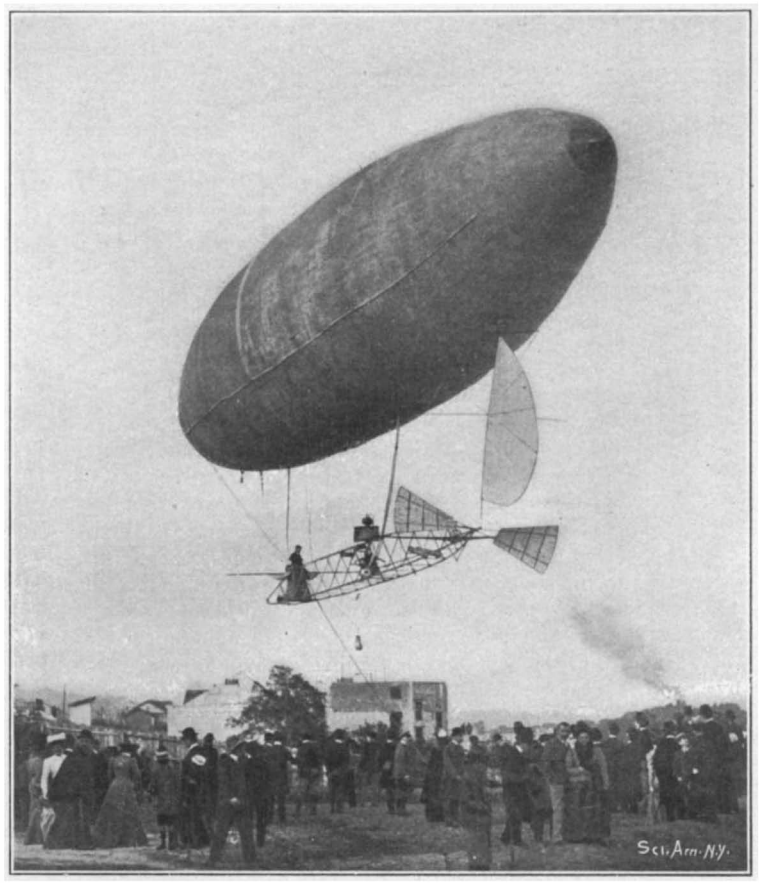
SANTOS-DUMONT WINS THE DEUTSCH PRIZE.

BY OUR PARIS CORRESPONDENT.

Now that the efforts of Santos-Dumont have been crowned with success, it may be of interest to retrace the steps by which the intrepid young aeronaut has been able to accomplish his present great triumph, which is of course only the first step in the work which he expects to carry out. Santos-Dumont is a Brazilian by birth, and was born in 1873; his father, who was of French descent, had a vast coffee plantation which employed as many as six thousand men in the fields and establishments. It was upon the forty miles of railroad which passed around the plantation that Santos-Dumont learned to conduct the small locomotives, and thus obtained his first knowledge of mechanics. He came to Paris while still quite young, and had already turned his attention to aeronautics. He at once commenced to work, and employed his large fortune and his talent in this direction. The result is that within three years he has constructed three spherical balloons and six airships. He began by making the record for the smallest spherical balloon, the "Brésil," which gaged only 140 cubic yards and had a diameter of 18 feet. It was made of fine Japan silk with cotton cordage and an extremely light wicker basket, and the whole weighed but 50 pounds. When it rose from the Jardin d'Acclimatation on the 4th of July, 1898, it seemed like an immense air bubble. After ascending out of sight, Santos-Dumont reappeared with the envelope packed in the basket. With this and similar balloons he made a number of interesting ascensions, but soon began the study of dirigible balloons. His "No. 1" is the first of the series, and started from the Jardin d'Acclimatation on the 18th of September, 1898. It was torn at the start on account of a false maneuver by the aids, but was soon repaired, and on the 20th he made a number of evolutions. But the small interior air-balloon, designed to keep the envelope always swelled out, was only insufficiently supplied by the ventilator, and thus the balloon, which was cigar-shaped, became more or less collapsed and folded upon itself under the tension of the weight. On this occasion the aeronaut had a fall of 1,200 feet at the rate of 12 or 15 feet a second, which, as M. Emmanuel Aimé says, is a record in itself. He came down on the Bagatelle training ground, however, without damage.

The "Santos-Dumont No. 2" was launched on the 11th of May, 1899, but during a rainstorm the balloon folded upon itself and could not be further maneuvered. An instructive test of the motor (gasoline type) and the helice was, however, made on this occasion. With this experience to guide him, he next built the "No. 3." It gaged 620 cubic yards, and was the first of the series to pass around the Eiffel Tower, starting from the Aerostatic Park of Vaugirard on the 13th of November. The "No. 4" is an improvement of this type and gaged 525 cubic yards; it was finished on the 1st of August, 1900. He went through a number of evolutions with this airship, notably on the occasion of the Aeronautic Congress, on the 19th of September, at the Aerostatic Park of the Aero Club. At the beginning of this year he finished the "Santos-Dumont No. 5," which made such a brilliant performance. It will be remembered that he started from the Aerostatic Park, crossed the Seine to the Longchamps race track, and then took the airship ten times around the track; he then came to the Trocadero, and after an accident to the rudder he started again, went around the Eiffel Tower, came back to Longchamps, and thence recrossed the Seine to the Aerostatic Park.

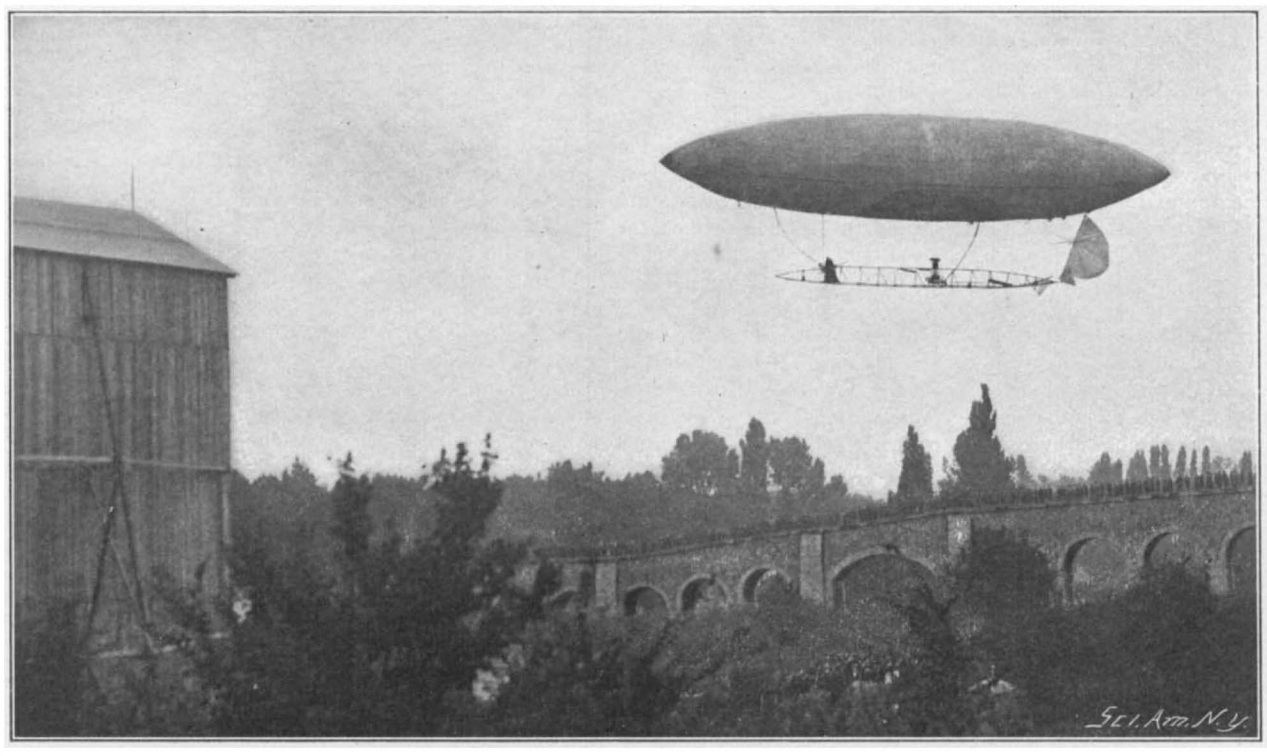
It was the Henri Deutsch prize that made the Tower the goal of the aeronauts, as the conditions of the prize of $20,000 were that the start should be made from the Park or vicinity, the aeronaut to pass around the Tower and return to the starting point within half an hour. Accordingly, Santos-Dumont, the day after the above experiments, started from the Park and passed the Tower, coming back in 40 minutes. But owing to a strong wind and an accident to the motor he could not land in the Park, but came down in the trees of M. de Rothschild's garden. It was after this that he had his famous accident, where, after passing around the Tower (8th of August) the motor stopped and the balloon was broken almost to pieces against the roofs of the Trocadero Hotel. Only twenty-



THE "SANTOS DUMONT No. 6" MANEUVERING IN MIDAIR

two days after this catastrophe the aeronaut, whose courage is proverbial, finished his "No. 6," with which he at last succeeded (October 19) in passing around the Eiffel Tower and returning within the half hour, or 29 min. 30 sec. Some time before this, however, the committee of the Aero Club had modified the original rules so that the airship was not only to come over the Park, but its guide-rope should be grasped by an attendant, this constituting a landing. Santos-Dumont was not able to comply with this rule, as before the rope could be grasped he was obliged to remount to avoid being carried by the wind against the balloon shed, and he came down 40 seconds after the allotted time.

The committee decided on November 4 as to this much-disputed question, and Santos-Dumont was accorded the prize.



DEPARTURE OF MR. SANTOS-DUMONT FROM THE AEROSTATIC PARK ON HIS SUCCESSFUL TRIP ON WHICH HE WON THE DEUTSCH PRIZE OF $20,000.

Fort Worth papers state that a conductor of the Chicago, Rock Island & Texas Railway, during the recent rush to El Reno to register for government homesteads, collected on one run 241 fares and tickets on the tops of the passenger coaches.

SOME EXHIBITS AT THE AUTOMOBILE SHOW.

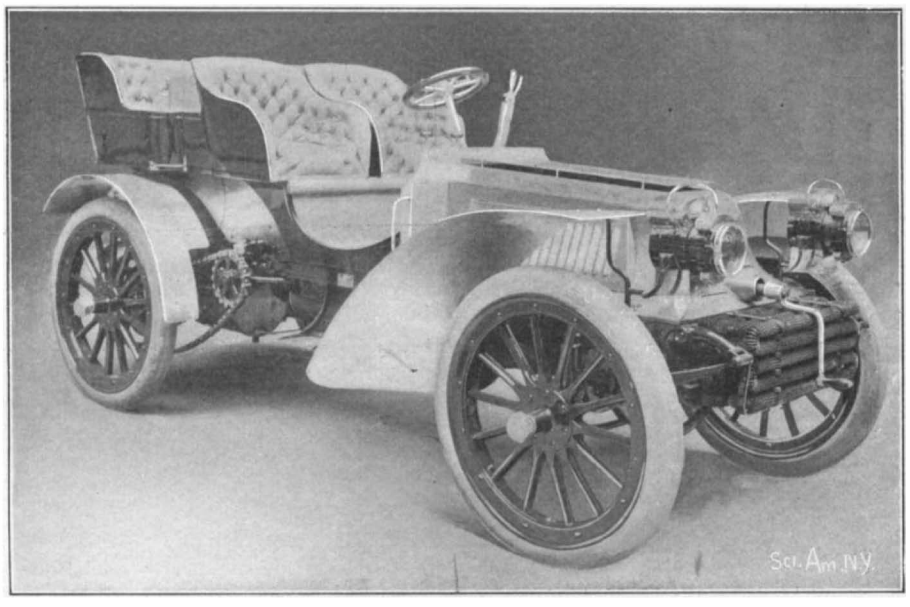
The second annual Automobile Show, which has just been successfully exploited at the Madison Square Garden, was a singularly sensible affair. Usually exhibitions of a similar character in any line of progressive industry teem with a curious assortment of mechanical fads and freaks that may entertain the eye in passing without, however, possessing the slightest practical merit. The Automobile Show was, however, purified of any such blemish on serious mechanical enterprise. It presented in a wholesome variety many types and styles of automobiles and accessories, all of practical use, some evincing great structural progress, while there was absolutely no exhibit of the freak kind.

One of the largest and most interesting stands in the big amphitheater was that of the Winton Motor Carriage Company, of Cleveland, Ohio. The new, improved, record-breaking vehicle, herewith shown, probably attracted the major share of popular attention. Its striking appearance is due in a measure to the doing away with the pyramidal bonnet containing the radiators, such as the 1901 racing models wear. Instead of being inclosed in the bonnet in front the radiators have been lowered so as to provide a smooth platform, which is not likely to obstruct the view of the chauffeur, and which will offer no wind resistance worth mentioning. This construction gives the vehicle an extremely racy look. It was on a machine of identically the same mechanical construction that Alexander Winton, president of the company, recently clipped off ten miles in the record time of 11 minutes 9 seconds, his fastest mile being the fifth, made in 1 minute 6 2-5 seconds. This performance is better than the track record of Henri Fournier, the French chauffeur champion, and when it is considered that Fournier uses a 60 horse power, 4-cylinder machine weighing fully 1½ tons, while Winton's racer is of but 40 horse power with two cylinders and weighing but 2,300 pounds, it is easy to see that the American maker has produced, mechanically and economically, a very much superior result.

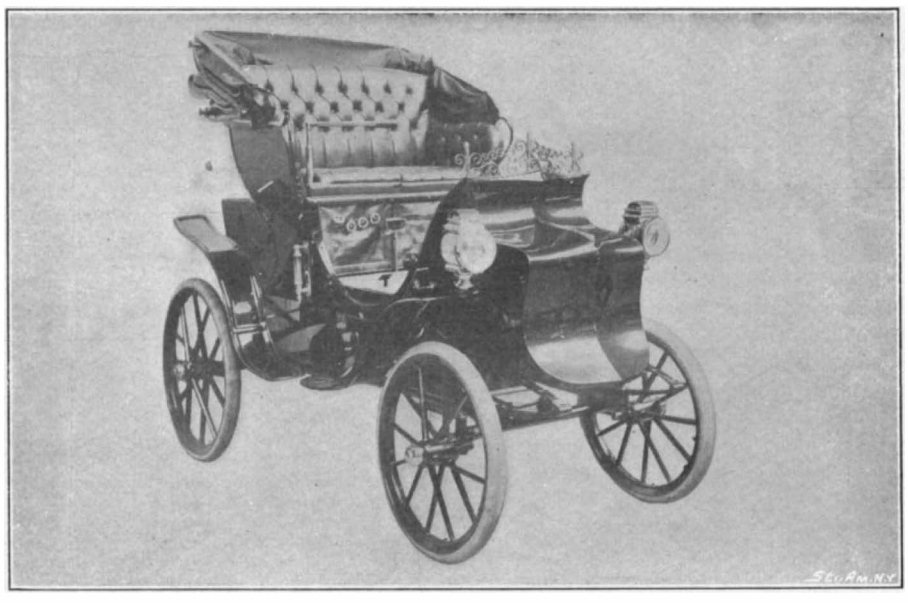
A curious cross between a horseless carriage and the victoria pattern in electric automobiles is the Elite, manufactured by D. B. Smith & Company, an exceedingly ornate and elaborate outfit on four wheels propelled by steam.

The Foster steam wagon's strong point is its compact and simple mechanism. Hence its makers thought it wise to show its "insides" in a skeleton vehicle, demonstrating clearly the manner of operation. As the mechanism is carried by the steel framework, the body has only to support the seat and passengers, and is, therefore, merely a shell, removable at will. This arrangement makes the machinery very accessible. It is possible, by removing the foot-boards, to stand, stoop, kneel or sit in front of the engine, with plenty of room for cleaning and adjusting it. The running gear is built of heavy-gage seamless steel tubing with solid reinforcements. The compensating gear is of the inclosed spur type carrying enough lubrication to run a whole season. The fire control has been improved by the introduction of a pilot light in connection with the burner, enabling the chauffeur to regulate the fire from his seat without change of position.

In its "New York" motorette the De Dion-Bouton Motorette Company has probably reached its highest present development, combining safety and efficiency with ample speed and a moderate price. The motor is water-cooled and capable of 5 horse power, which provides for speeds up to 22 miles an hour. The weight of the entire machine is only 800 pounds. The exhaust control and reversing gear have been greatly improved. The foot-brake pedal first regulates the exhaust, thus at once reducing the speed, simultaneously with muffling the noise, a feature of considerable importance in

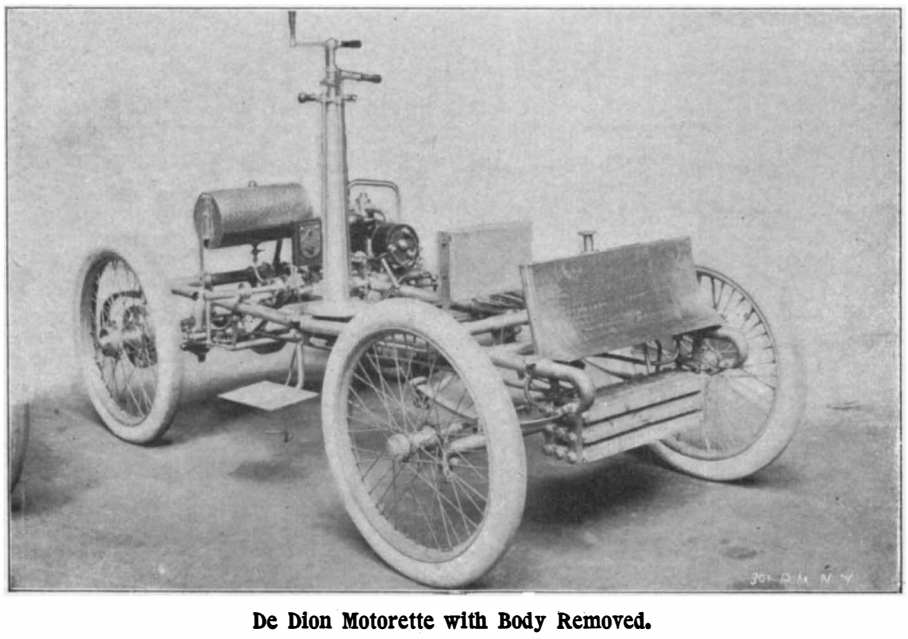


35-Horse Power Gasmobile.

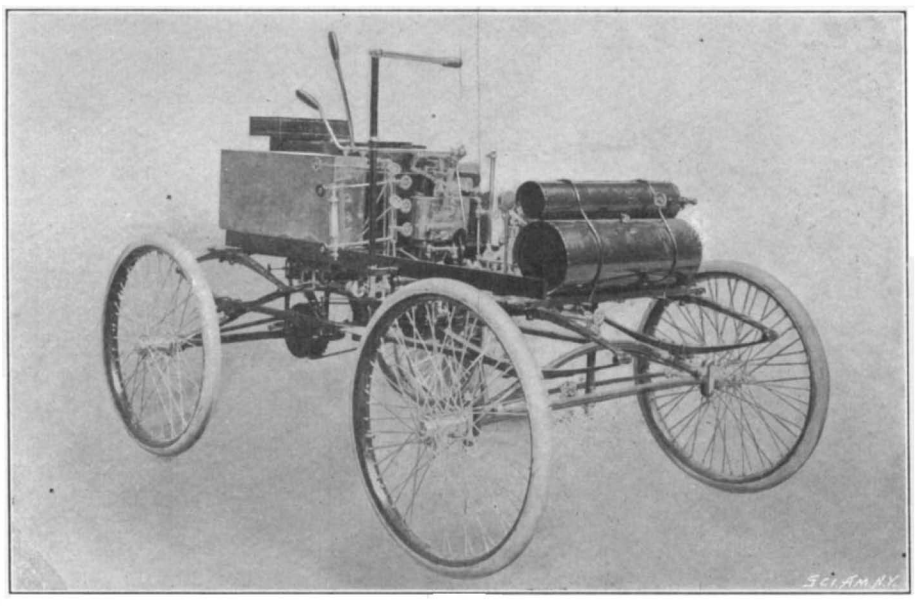


The Elite; a Steam-Driven Victoria.

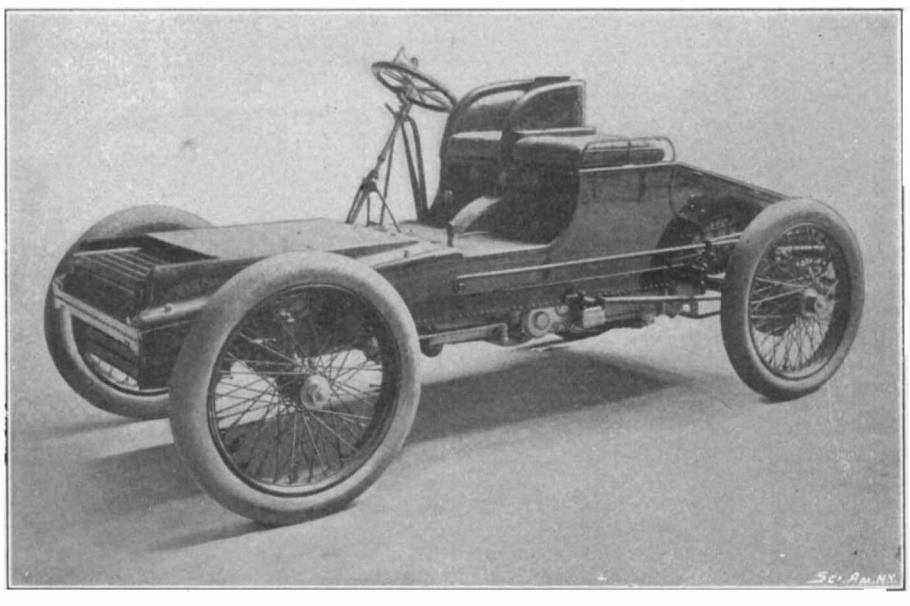
De Dion Motorette—"New York" Type.



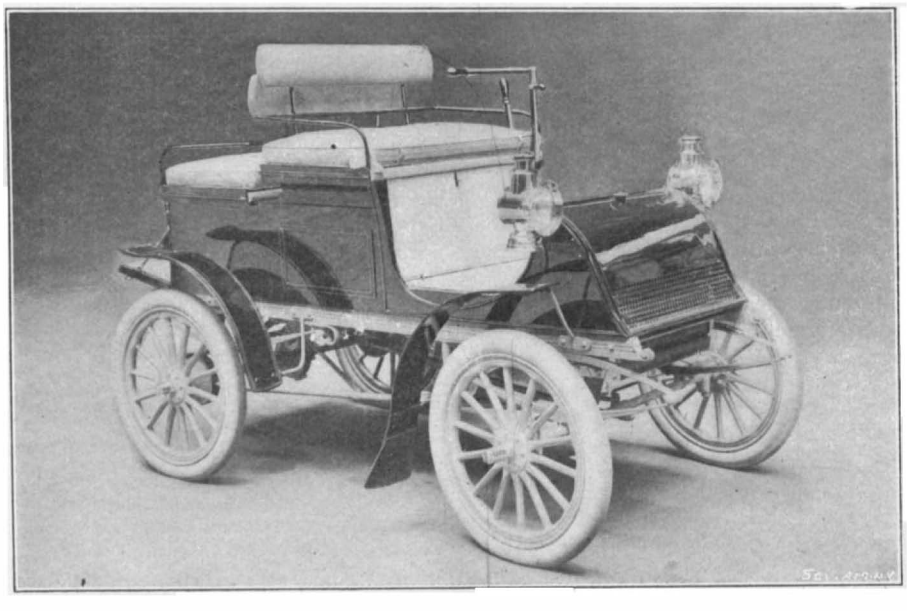
De Dion Motorette with Body Removed.



The Foster Steam Carriage with Body Removed.



Winton 40-Horse Power Racer—Record of 10 Miles in 11m. 9s.



The Autocar.

Haynes-Apperson 9-Horse Power Surrey.

SOME EXHIBITS AT THE AUTOMOBILE SHOW.

passing restive horses. A further application of the foot-pedal applies the differential brake. It was a standard vehicle of this model that outdistanced its competitors of the same class in the New York-Buffalo Endurance Trial, being the only light gasoline vehicle to win a first-class certificate on an average of 12 to 15 miles an hour over mud roads for five consecutive days.

The makers of the autocar claim that it cannot blow up or burn down, and after an examination of its distinctly automatic features it must be confessed that the claim appears to be well founded. The interchangeability of the parts is another noteworthy feature of this car, which has quite a military air, mainly suggested by its wooden wheels of the artillery type. The equipment consists of a balanced double-cylinder gasoline motor of 8½ horse power, the cranks and moving parts being inclosed in an aluminium case, excluding all dust and facilitating the utmost ease of lubrication. The transmission gear, also inclosed in aluminium casing, provides for a range from 8 to 21 miles per hour ahead, and a slow reverse covering all the requirements from a level to steep hills. Six gallons of gasoline, sufficient for 100 miles' touring, are carried under the forward hood. The control of the vehicle is effected by two levers, one operating the clutch and throttle valve; the other for gear changing.

The Haynes-Apperson vehicles, which made such a fine record for themselves in the New York-Buffalo Endurance Run, are probably the handiest and most reliable small-size, high-power automobiles as yet produced in this country. The new 9-horse power surrey recently completed by the firm was on exhibition. It disclosed many improvements, notably in a more direct transmission gearing, a better method of lubrication, a water circulation by radiator and pump, and a new model of steel rims. The makers, who have the benefit of eight years' experience in the automobile industry, are still retaining their well-known double-cylinder engine of the horizontal opposed-cylinder design with but few alterations, and all the vehicles have forward speeds of 6, 12 and 25 miles per hour.

The electric truck for carrying and hoisting safes by its own motive power, exhibited by the Hall's Safe Company showed by actual hoisting tests of many safes that it was good for the claims made in favor of it by its makers, the Vehicle Equipment Company, of Brooklyn, N. Y. This truck has been in the market but a very short time. It is able to transport several safes at a fair rate of speed and hoist them into the loftiest sky-scraper extant in less time and with less expenditure than by means of the ordinary hand truck.

The biggest machine produced in America is the 3,300-pound gasmobile, the ponderous and resplendent appearance of which has fascinated those automobile visitors, who love a big machine and high speed. This leviathan of the "teuf-teuf" family relies for its power on a 6-cylinder engine capable of 35 horse power—an unusually large amount of power for a touring vehicle of such dimensions.

Pearl Fisheries of Venezuela.

The pearl fisheries of the island of Margarita, on the coast of Venezuela, have become quite important within recent years, and are now extensively worked. The pearls of Margarita Island have been known ever since the discovery of the country. The Indians of the time of Columbus were already provided with ornamental objects in which pearls figured prominently, and it seems to have been these pearls which occasioned the first difficulties between the Spaniards and the inhabitants. During the last few years the oyster beds of the island have been more and more actively worked. At present there are about 400 sail boats with native equipments working about the islands of Margarita, Coche and Cubagna. The principal oyster beds are those of El Tirano, to the northeast, and Macanao, to the northwest of Margarita. It is estimated that at present as many as 2,000 men are occupied in the oyster fisheries. Metallic drags are used, which are drawn over the oyster beds. The boats have a tonnage of 3 to 15, and pay a tax of $3 a year to Venezuela. The pearls are of a fine quality, generally white or yellow. Sometimes a black pearl is found, but this is rare, and it brings a high price. Not long ago a white pearl was sold for nearly $2,000. The shell of the pearl oyster is not of any great value, as it is too thin to be utilized. The Margarita oyster has a relatively short life and on an average it does not exceed eight years. A French company has been lately formed for the pearl fishery. It will operate, not by using drags, but by divers, with and without suits. In this way the smaller oysters will be spared, and the beds will not be depopulated. The value of the annual production of the Margarita Island region is over $600,000. Most of the pearls are sold in the Paris market, where the sale appears to be the most active and the best prices are obtained.

On a dining car of the New York Central recently, 318 dinners were served without re-stocking the car.

THE WHEEL WITHIN WHEEL.

The inventor of this innovation in automobile construction has attacked the tire problem in a novel manner by placing the pneumatic tire where it will not need to come in contact with the roadbed, yet in such a position that its full cushioning effect will be obtained. "The Wheel Within Wheel," as its name denotes, consists in reality of two separate wheels on two separate hubs, one within the other. The rim of the smaller or inner wheel is bound to the outside flanges of the hub proper (which flanges form the outer of the two hubs) by wire spokes, while that of the outside wheel is rigidly held in place by large metal spokes radiating from the center or inner hub. The hole of this hub is somewhat larger than the axle, and the hub has no bearing surface on the axle. The hub is narrow and is, in reality, a sort of flange with a groove running across its face. (*a*, Fig. 3.)

The outer flanges of the hub proper, that is, the flanges forming the hub of the smaller wheel, have each a groove across their inner faces. The floating guide-ring (*b*, Fig. 3) has two lugs on each face, the line of the two lugs on one side being at right angles with the line of the two lugs on the other. Two of

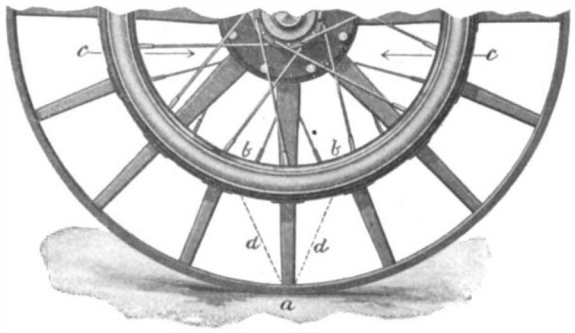


Fig. 1.—Side Elevation of Half of Wheel.

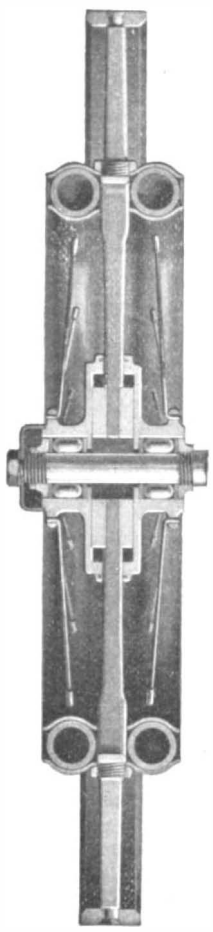


Fig. 2.—Section Through Wheel Center.

these floating plates make the driving connection between the outer hubs and the inner one, and, as the lugs slip loosely in the grooves of the side and center hubs, the latter can slide on each other either vertically or horizontally at the same time.

The rim of the smaller wheel is made double, and two pneumatic tires are mounted thereon,

Fig. 3A.—Central Hub.

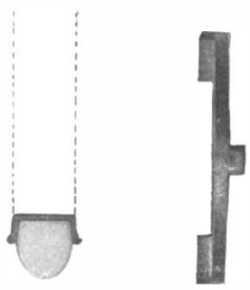


Fig. 3B.—Side Elevation of Floating Guide Plate.

THE WHEEL WITHIN WHEEL.

one on each side of the spokes of the large wheel. Two bearing rims attached to these spokes bear on the tires and cushion the large wheel on the small one. As the tires are double, and as the bearing surface on them is on about half their circumference, instead of at a single point, they need not be inflated as hard as usual, and so give a much greater cushioning effect. A wheel with 15 pounds air pressure in the tubes will carry 500 pounds weight at least. The wheel has been tested by several manufacturers, who expressed themselves favorably as to its merits. A gasmobile exhibited at the recent Automobile Show was equipped with a set of these wheels.

Demand for Electric Plant in Greece.

Consul McGinley reports from Athens, September 12, 1901, that the Mayor of Kerpenesion, a village in the Province of Evrytania, wishes to have that place lighted by electricity, and has requested the consulate to publish the fact in the United States, hoping to induce some American company to sell him a suitable plant. There is a stream near the village that can be utilized to furnish the necessary power for the plant. There are 400 houses in the village, and the Mayor estimates that about that number of incandescent lights will be required. He does not mention the number of arc lights required. Karpenesion is the village which the heroic Greek chieftain, Marco Bozzaris, was defending when, in 1823, he fell in a midnight sortie against the Turks, an event made famous by Fitz Greene Halleck's stirring poem.

Electrical Notes.

Consul Berliner reports from Teneriffe, October 4, 1901: For some time the direct cable between Teneriffe and Europe has been broken; also the cables connecting the different islands. All the islands are now cut off from the outside world, except Teneriffe, which has cable connection with Bathurst, Africa. The charges from Teneriffe to New York, formerly 2s. (49 cents) per word, are via Bathurst 6s. ($1.46) per word.

The tramways of Paris and its suburbs are in the hands of 11 companies working 53 lines, with 832 cars for mechanical and 297 for horse power. The following systems are used: (*a*) For electric traction—trolley, 1 line; plow, 5 lines; system Diatto, 12 lines; system Claret et Vuilleumier, 1 line; accumulator, 19 lines. (*b*) Compressed air, 9 lines. (*c*) Steam, 5 lines. (*d*) Rope, 1 line. The trolley system is not allowed within the city, and has only been granted provisionally to one line, Bastille-Charenton.

It has been necessary to tear out an expensive marble switchboard which was built in the electrical power house at "Idle Hour," Mr. W. K. Vanderbilt's estate in Oakdale, L. I. Ever since the marble board was put in the current has been erratic, says The Electrical Review. It was finally determined that the trouble must be in the switchboard. A careful investigation revealed the fact that the marble contained a vein of iron sufficiently well developed to form an occasional short-circuit. A new switchboard is to be constructed and the old one torn out.

The Electrician states that a proposal has been submitted to the municipal authorities at Rouen, by the chief of the fire department, for the utilization of the tramway trolley wires in connection with the extinguishing of fires. All the principal thoroughfares of the town are provided with electric tramways, and the proposal is that pumps capable of being electrically driven should be installed in a number of suitable positions on the tramway route, to be switched on to the trolley wires, so that the pumps may be used as occasion necessitates. The proposal is said to have been favorably received, and is now under the consideration of the authorities.

The enormous strides that have attended the development of telegraphy during the nineteenth century are strikingly illustrated by some statistics recently issued by Sir W. H. Preece, K. C. B., late electrician to the English Post Office. In 1870 the number of words transmitted per minute was only 80; in 1890 the number had been increased to 450. In 1870, 9,850,177 messages were dispatched throughout the United Kingdom, at a cost of $3,061,505, while in 1900, 89,576,961 telegrams were sent, bringing in a revenue of $17,296,765. The total number of government and private cables encircling the globe is at present 1624, covering a total length of 187,353,172 nautical miles.

It has now been practically settled that the Colorado and Southern Railroad will install electricity as a motive power on all its suburban lines running out of Denver. During the summer an expert was sent to Europe to investigate the various electric systems in use in Berlin and other cities, and to report on the advisability of adopting any of them. This expert has recently returned, and reports that the change to electricity is entirely feasible and will not involve a cost which this recently reorganized system would not be able to sustain. It is expected that the recommendations which he will submit will be acted upon definitely within a very short time. The suburban lines on which this change is to be made are five in number, entering Denver from different directions. The road also contemplates changing its locomotive fuel from coal to oil.

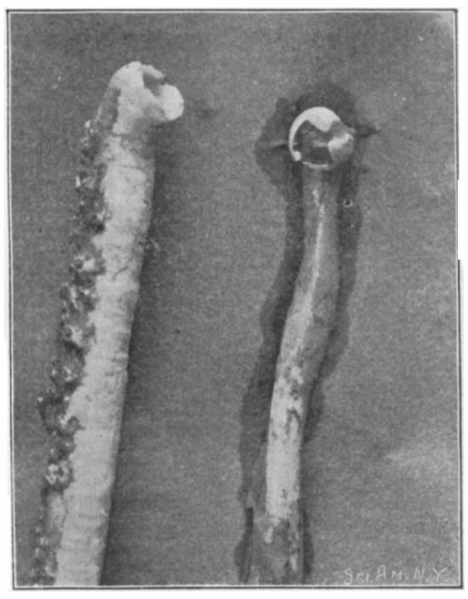
It is intended to utilize electricity in lieu of steam for subsidiary purposes upon the vessels of the English navy more extensively than at present. A series of prolonged experiments are to be made to ascertain the range of the practicability of using this power for this purpose. At present the capstan, steering engines, ventilating fans and derrick hoists on the vessels are manipulated by steam, necessitating the construction of a bewildering network of pipes in the interior of the ship. The new armored cruiser "Hogue" is being fitted with electric wires, and the entire subsidiary gear will be controlled by electricity. Should the experiment prove successful, the system will be extended to all other vessels refitting, as well as those under construction. A modern English battleship now carries a small staff of electrical engineers, so that no alterations will have to be made respecting the crew.

THE TEREDO AND ITS WORK.

BY J. G. M'CURDY.

Of the various forms of animal life that cause damage by their habits of boring into various substances, the Teredo navalis, or "ship-worm" as it is commonly called, easily heads the list for general destructiveness. It is found in every sea, and every piece of unprotected timber immersed in salt water is subject to its ravages. It works secretly, silently and effectually. A timber may appear perfectly sound upon the surface, but upon cutting into it, it will be found fairly honeycombed with the passages drilled by this indefatigable miner.

Teredos belong to an old and well-scattered family. They were well known to the ancients, who found



TEREDO AND CALCAREOUS LINING OF TUBE.

the problem of protecting their ships' bottoms from the ravages of the pest a most serious one. In 1731 Holland came near suffering an inundation through the agency of these creatures. The Zeeland dikes were found ready to collapse by reason of long-continued attacks on the part of teredos, and had not the situation been discovered most deplorable consequences must have resulted. The teredo is a cylindrical, worm-shaped creature, and as found in Pacific coast waters is usually about a foot in length and rarely exceeds half an inch in diameter. The head contains the boring apparatus, which consists of two peculiarly shaped shells. These working together have an action closely resembling an auger bit. The long, whip-like body is nearly transparent and so tender that it will hardly bear its own weight. The creature bores into the timber when it is very small and at once commences active labor. It invariably bores in the direction of the grain of the wood, unless turned aside by some obstacle in its path, such as a knot, spike or another burrow.

It lines its tube-like passage with a thin calcareous deposit, which serves as a protection to its crystalline body. No matter how many teredos may be operating in the same piece of timber, no excavation will be found breaking into another. How the artisans, working within the interior of the timber, can so unerringly avoid obstacles in their path is a puzzle to scientists. The section of a log pictured herewith measured but 18 inches in diameter, yet contained over 800 teredo holes by actual count.

To obtain a live teredo means a diligent and in many cases a disagreeable search. The writer made a number of visits to various wharves, but it was not until an extremely low tide that success attended his quest. Great care must be exercised in dislodging the creature if it is to be kept intact, while photographing the soft, watery mass will prove no easy task.

Many persons erroneously charge the teredo with the damage done by limnoriæ, minute insects that swarm upon the surface of immersed timbers and eat in toward the heart. Every piece of piling is beset with enemies within and without, and it is always a question which will cause the ultimate destruction of the timber.

The teredos bore into the lower end of the pile in such numbers that at length it breaks off and floats away; the limnoria makes its attacks at about half-tide mark, and if given sufficient time, will eat the timber completely in two. Where the bottom is foul and muddy, the teredo completes its work first; but on a firm, sandy bottom, the limnoriæ win the day. The teredo does not work with the same rapidity in all waters. They are worse in Alaska than in Southern California, and at various points upon Puget Sound but a few miles distant from each other they work with varying degrees of voraciousness, much depending upon the character of the bottom. A wharf left to itself soon becomes a tottering ruin. They are carefully watched, and as quickly as piles are destroyed they are replaced by a pile driver, which drives new timbers into the bottom with an immense hammer operated by steam power.

Loggers are careful to construct their booms in places where streams mingle with the salt water in order that their logs may not be injured before reaching the sawmill. The Robertson Log-Raft Company recently removed its plant from Puget Sound to the Columbia River in order to escape the teredo, which rendered one-third of its timbers worthless before a raft of sufficient size could be got together for towing.

How to protect timbers from their insidious foes has been under consideration for years. In 1868 Dr. Avenarius, a German chemist of note, made a preparation from creosote which was fairly effective, but it did not meet with general favor on account of its inflammability, evaporation and destructiveness to wood fiber.

A few years later Dr. Avenarius invented a coal-tar distillation which proved of great merit, and most of the preservatives now in use are compounded largely in accordance with his formula. Copper or yellow metal sheathing is also efficacious.

The creosote process consists in a forcible injection into the fiber of the wood of dead oil of coal tar as obtained in the manufacture of gas.

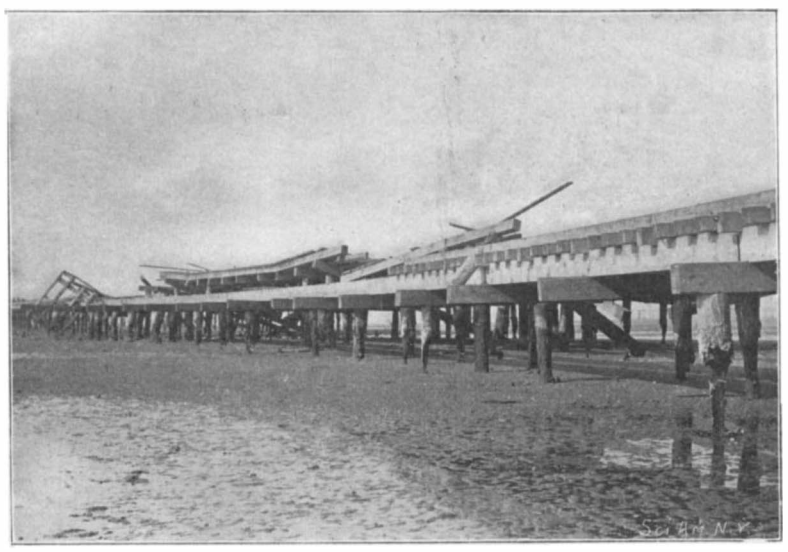
Copper sheathing consists in a coating of copper or yellow metal (sometimes called Muntz metal) similar to sheathing on the bottoms of vessels.

It is well understood that there are numberless materials which will keep the teredo from destroying wood, provided they can be made to stay on the wood; but the solving action of salt water is so great that it will destroy the great percentage of them. In Southern California a considerable quantity of eucalyptus piling is used. This wood withstands the action of the teredo for from three to seven years, but the growth is limited in quantity and size, and is not of sufficient importance to cut any figure commercially.

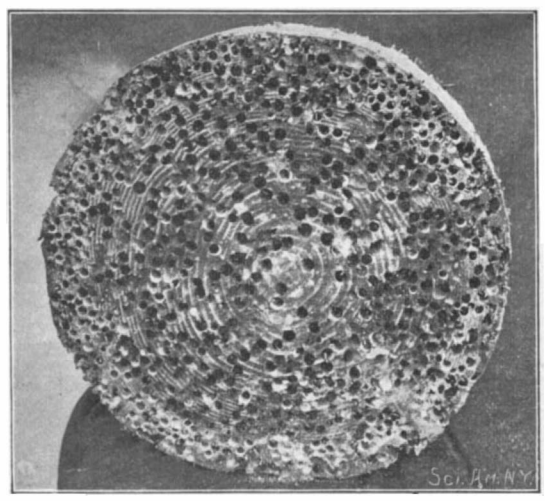
The government demands the use of pest-proof timber in all its wharves and harbor works, and railroads and other private enterprises are following the example. The writer recently made a careful examination of a dock built of prepared timber which had been built for several years, and could not find the trace of a teredo. In the fender-piles, however, which were unprotected, teredos and limnoriæ were holding high carnival.

Glass for Scientific Purposes.

In the course of a paper by Dr. Glazebrook, read before the British Association, the author said that the theory of an ordinary achromatic object-glass was well known. In consequence of the fact that in a prismatic spectrum the ratio of the dispersion of the extreme rays to the deviation of the mean ray was different for different materials, it was possible to construct two prisms so as to produce a resulting deviation, but not separation of two given rays. The image formed when the two extreme rays were combined was not white, but exhibited prismatic color. If an ordinary lens of crown and flint glass were achromatized for the rays C and F, then, for the flint glass, the dispersion of the blue end was greater than that of the red end, less for the crown. A more completely achromatic result would be obtained by using two glasses, for which, for given equal total dispersion, the distribution of the rays in the two spectra was more nearly the same. After referring to the work of Abbe, Stokes, Harcourt, and others, Dr. Glazebrook said that among the glasses manufactured at Jena it was possible to find various pairs which could be combined into better achromatic lenses than the old crown and flint. It was necessary for this purpose that the ratio of the total dispersion to the refractive index should be different for the two glasses but that the ratio of the partial dispersion to the total should be the same. He then showed how three colors might be combined in the image instead of two, as in the older manufacture. In such an object glass the advantages were numerous. It was more nearly white than that formed by a lens of two ordinary glasses, and as a consequence would stand a higher magnification in the eyepiece. As a result the whole instrument might be made more powerful, or, for the same resultant magnifying power, we might use a less powerful object-glass, and thus secure other advantages in illumination. There would be with such a lens some outstanding chromatic aberration, the violet image being rather greater than the red. This was corrected in the eye-



WHARF DESTROYED BY TEREDOS.



CROSS-SECTION OF PILING, SHOWING 800 TEREDO HOLES, NO TWO HOLES BREAKING INTO ONE ANOTHER.

piece itself. Attempts had been made either to use fluorspar in the object-glasses, or to make glass containing fluorine. With such a glass it would be possible to obtain almost perfect conditions.

Plans for the Moscow-Kasan-Kyschtymsk Railroad Approved.

According to German newspapers, the standing Russian railroad-building commission has just approved the plans for the Moscow-Kasan-Kyschtymsk Railroad. The present outlet of the great Trans-Siberian Railroad —the Ssamara-Slatonster Railroad—is so overburdened with freight that it can no longer handle the amount of goods delivered. It has become necessary to find other means to relieve trans-Siberian traffic, and the so-called North Railroad, which connects Viatka, via Vologda, with St. Petersburg, and the Moscow-Kasan-Kyschtymsk line, which has been projected by the Moscow-Kasan Railroad, will be made to serve the purpose. The former line is already laid out and contracts are being made with foreign firms for its construction. The building, equipping, and running of the latter road has been turned over to the Moscow-Kasan Railroad Company by the commission, under condition that it be completed at once and that the necessary rails and cars be ordered from Russian factories.

The Current Supplement.

The current SUPPLEMENT, No. 1350, has a number of unusually interesting articles. "M. Santos-Dumont Wins the Deutsch Prize" is accompanied by a large engraving showing the descent after the successful journey. "A Military Bakery Automobile" describes an interesting flour mill and bakery which transports itself. "Modern German Fire Engines" illustrates some modern types. The second important series of "Enameling" is published in this issue. "The Berlin-Zossen High-Speed Electric Railway" gives full details of this remarkable experimental line. "Anthropology" is an address by Prof. D. J. Cunningham, M.D. "Reflex Action and Instinct" is by W. Benthall, M.D.

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

BINDER ATTACHMENT. — WILLIAM M. CLARK, Boscobel, and ALBERT M. DAVIS, Madison, Wis. This invention relates to a binder-breastplate which is mounted to move in unison with the needle. As the needle embraces the gavel and crowds it toward the trip-arm the breastplate moves down toward the arm and assists the needle in the work of compressing the gavel, thereby relieving the needle of much of the work which it was hitherto called upon to perform.

CUTTER-BAR.—ALONZO. F. BENN, Ridgway, Penn.—The cutter-bar is constructed so that the knives are quickly and conveniently removed and replaced, and so that when the knives are in position in the bar they are readily locked in place. By means of the locking mechanism, the knives can be adjusted; and any slack caused by wear on the abutting edges of the knives is automatically taken up.

Vehicle Accessories.

AXLE-BOX WASHER. — DR. JAMES W. BRYANT, Crewe, Va. The invention is an improvement in washers and boxes for vehicle-wheels, in which a metal ball-bearing spring washer is used in place of the ordinary flat leather or metal washer. The objects of the improvement are to prevent friction and the consequent wear of the several parts, thus rendering the vehicle more lasting; to reduce the draft of the vehicle; and to prevent the disagreeable clicking sound heard in all vehicle-wheels after slight use, due to wear of the parts.

Engineering Improvements.

AUTOMATIC BOILER-FEEDER.—HENRY J. DAVIS, PLAYFAIR G. AULT and JAMES H. WIDEMAN, Birmingham, Ala. These inventors have devised an improvement upon boiler-feeders for which they have received U. S. Letters Patent. These patents cover certain constructions, combinations, and arrangements of steam and water inlet and outlet valves, and floats and connected mechanism for actuating such valves, the whole being so arranged in connection with a tank as to recharge a boiler automatically whenever the water level therein is lowered below a certain predetermined point of safety. The inventors have devised improvements in the construction and arrangements of valves and connected mechanism, with a water-tank, and a preliminary water-heater and steam-condenser whereby practical advantges of considerable importance are secured.

STEAM-ENGINE.—ROBERT H. BOTTS, Richmond, Cal. Mr. Botts has devised a very light and simple form of steam-engine designed primarily to be used on an airship of which he is the inventor. The steam-engine comprises a crank-shaft with which the cylinder is directly connected. A non-reciprocating piston with valves is arranged in the cylinder and connected with hollow piston-rods, forming induction and exhaust pipes. Right angular connections for the pipes are provided. Stationary stuffing-boxes form axes of oscillation.

Metallurgical Apparatus.

GUIDE FOR STAMP-MILLS. — EDMUND MAJOR, Denver, Colo. The guide consists of front and back clamping plates, and a tie-rod or bolt having an enlarged or swaged portion intermediate of its ends to engage one of the clamping-plates and hold it in position independently of the other plate. One end of the tie-rods serves to hold the other clamping-plate. Should one of the bolts break, the other will hold the parts in place until repairs can be made. The swaged portions on the bolts cause the back plates to be held in position independently of the front plates, and owing to the peculiar construction of these parts they are all held with the autmost security.

CORONET-ROLLS. — ALBERT C. CALKINS, Los Angeles, Cal. In the assay-laboratory considerable difficulty has been experienced in inserting the bullion button between the rolls. The present invention is in the nature of a simple, compact, and powerful little machine designed to insure the positive feed of any bullion button inserted between the rollers. The machine is conveniently manipulated and quickly rolls the bullion button into foil or strips of the desired thickness.

AMALGAMATOR.—HUGH M. SMITH and RALPH SAILEY, Libby, Mont. The object of the invention is to provide a shaking amalgamating-pan of simple construction, so arranged that the pan can be easily removed from its supporting frame, but held perfectly solid when in place. The pan is supporting a skeleton frame. A bolster is secured to the frame and mounted to slide on the lower portion of the table. A bolster for the upper frame is also provided, consisting of removable sections. Slide-bars are attached to the bolsters and move in boxings on the table. The bolsters are connected with a crank-shaft. A lateral reciprocating motion is imparted from the crank-shaft. In operation the machine will be placed in position in lieu of the stationary plates now used in stamp-mills and receive the slime or crushed ore from the battery constantly. The table or pan, as it reciprocates, causes the gold to amalgamate faster and more thoroughly than any stationary pan.

Mechanical Devices.

SPEED-CHANGING MECHANISM.—DEFIANCE MACHINE WORKS, Defiance, Ohio. Mr. George A. Ensign, well known for his numerous inventions in woodworking machinery, has devised an improved speed-changing mechanism for axle-shaping machines. The mechanism is arranged automatically to change the speed of a carriage or other movable part of a machine traveling in one direction and to stop the carriage or movable art whenever it reaches the end of its stroke. The mechanism consists of a shaft carrying loose pulleys and driven pulleys. A double friction-clutch is mounted to slide on and turn with the shaft and is adapted to be thrown in mesh with any of the pulleys. The double clutch is operated by a shifting-lever connected with a sliding-block. A second sliding-block has spring connection with the first-named sliding-block. The blocks can be moved in opposite directions. Locking dogs are provided for engaging and locking the blocks in an outermost position, which dogs can be successively thrown out of engagement with the blocks whenever desired.

GLUING OR PASTING MACHINE.—FREDERICK W. BROWN, Berlin, N. H. This improved glueing and pasting machine is designed especially for securing a burlap lining on a sheet of wrapping paper and coating the latter with an adhesive substance to secure the article formed upon the ends and edges of paper rolls, especially large newspaper rolls, to protect the edges of the rolls from damage during transportation, loading, and general handling.

SAWMILL-CARRIAGE GEAR.—ELWIN S. BERRY, Putnamville, Vt. Ordinarily the carriage is drawn back in the same line in which it was advanced, thereby warping the log against the saw. By means of the present invention, however, when the carriage is to be gigged or returned to the staring point, it is first moved sidewise slightly, so as to clear the log from the saw, whereupon the return movement is effected.

Tools and Implements.

REPAIR-LINK. — FLETCHER G. ASBILL, Ridgespring, S. C. The invention relates to links provided for the repair of broken trace-chains or other chains. The object is to provide a very simply repair-link, which is light, strong, easily applicable to a broken chain. The device is especially applicable as a lap ring, or in lieu of a lap-ring such as is used ordinarily to connect a singletree and clevis to plow-beams.

DOUBLE-ACTION SAW-SET.—DUANE M. ROBERTS and JOSEPH H. MARA, Marlow, Ind. Ty. In every saw, either all of the teeth or certain alternate teeth must be bent outward from the imaginary plane passing through the saw-blade. This operation is necessary both in new saws and in those in which through use in sawing the teeth have been closed or partially closed by the pressure of the material sawn. The device forming the subject of this invention is especially designed for the purpose of bending the teeth to the proper angle and likewise to prevent buckling of the saw. The punches used in this device each act as an anvil for the other, so that the pressure of either punch has practically no effect except that of bending a tooth. The curved guideway provided prevents undue motion of the saw-blade and also assists in preventing the saw from coupling.

Miscellaneous Inventions.

SURGICAL DEVICE.—HENRY W. POST, Fultonville, N. Y. The invention is an obstetrical device comprising a strap adapted to slide on the end board of a bedstead, and slide-plates mounted to move toward and from each other on the strap. Loops have swinging connection with the plates; and hand-grips are mounted on the loops.

AIR-VALVE FOR WATER-COCKS.—WILLIAM PAUL, Savannah, Ga. The invention provides in connection with a water-cock an air-inlet controlling-valve held normally in closed position by water pressure, but automatically opening upon opening the drain-cock to permit the entrence of air, so as to cause a thorough draining of the pipe in freezing weather.

SURGICAL INSTRUMENT CASE.—MAX W. BECTON, Manhattan, New York city. The case is arranged to carry hypodermic syringes and accessories. An instrument-carrier having suitable sockets or clamps is hinged to the case, the connection being such that the carrier will be borne flat in one section of the case, and can be readily turned over into the opposing section. The carrier-case may be therefore rendered aseptic, and the carrier raised from the case, affording ready access to the contents.

FRUIT-BASKET.—HENRY C. FINLEY, Oklahoma, Oklahoma Ty. This light and cheap pasteboard substitute for the wooden grape basket in ordinary use consists of a body and bottom secured together. A handle is provided with tongues which pass down upon the outer side of the body and also upon the inner side. The pasteboard body and bottom of the basket are rendered water-proof by the application of some suitable composition. The construction provides a basket well adapted for its purpose, which basket is much lighter and can be constructed at much less cost than the ordinary wooden baskets.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 1575.—For the manufacturer of the Home Sharpener, an emery wheel attachable to any sewing machine.

For logging engines. J. S. Mundy, Newark, N. J.

Inquiry No. 1576.—For manufacturers of electric automobile trucks or wagons for carrying not less than 3,000 pounds.

TURBINES.—Leffel & Co. Springfield, Ohio, U. S. A.

Inquiry No. 1577.—For machines for making butcher skewers.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 1578.—For machinery for separating materials in refuse and afterward grinding and mixing, after which it is pressed into balls, bricks, etc.

WATER WHEELS. Alcott & Co., Mt. Holly, N. J.

Inquiry No. 1579.—For manufacturers of electric belts.

Gasoline Lamps and Systems. Turner Brass Works, Chicago.

Inquiry No. 1580.—For manufacturers of nickel or nickel alloy tubes for gas engines.

Foot presses and dies. Amer. Hdw. Mfg. Co., Ottawa, Ill.

Inquiry No. 1581.—For a suction pump for cleaning cisterns without drawing out all the water.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 1582.—For manufacturers of gas engines from 1-16 to 1-2 horse power.

Machine chain of all kinds. A. H. Bliss & Co. North Attleboro, Mass.

Inquiry No. 1583.—For manufacturers of small dynamos to run 12 to 15 incandescent lights.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 1584.—For manufacturers of small steam siren whistles.

For Sheet Brass Stamping and small Castings, writ Badger Brass Mfg. Co., Kenosha, Wis.

Inquiry No. 1585.—For manufacturers or dealers in household novelties.

Rigs that Run. Hydrocarbon system. Write St. Louis Motor Carriage Co., St. Louis, Mo.

Inquiry No. 1586.—For dealers in children's musical or toy novelties.

Ten days' trial given on Daus' Tip Top Duplicator. Felix Daus Duplicator Co., 5 Hanover St., N. Y. city.

Inquiry No. 1587.—For turbine water wheels.

Machinery designed and constructed. Gear cutting. The Garvin Machine Co., 149 Varick, cor. Spring Sts., N. Y.

Inquiry No. 1588.—For parties dealing in No. 8 steel rails 30 feet long.

New Book, Electric Gas Lighting, 50c. Send for full descriptive circulars, free. Spon & Chamberlain, 12 Cortlandt Street, New York, U. S. A.

Inquiry No. 1589.—For machinery for making clothes pins.

Manufacturers of patent articles, stamping dies, tools, light machinery. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 1590.—For machinery for making butchers skewers.

Designers and builders of automatic and special machines of all kinds. Inventions perfected. The W. A. Wilson Machine Company, Rochester, N. Y.

Inquiry No. 1591.—For manufacturers of machinery for cutting, splitting and bundling wood.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 1592.—For machinery for making round hardwood handles, etc., for pails, tubs, etc.

MECHANICAL SUPERINTENDENT WANTED. — Familiar with the manufacture of firearms on a large scale, possessing executive and mechanical ability. Address, stating age, experience and references, A, Box 2123 General Post Office, New York.

Inquiry No. 1593.—For manufacturers or dealers in machinery for making paper boxes.

WANTED.—A competent and energetic draughtsman, about 33 to 35 years, up in modern methods, to take charge of small machine shop. Good pay to right man. One familiar with bleaching and dyeing machinery preferred. Address, giving full information and wages expected, B. B., No. 32 Kent St., Somerville, Mass.

Inquiry No. 1594.—For the address of the manufacturers of the "Hat Mirror and Hat mark," also "Duke's Scissor Thimble."

FOR SALE.—Three bias cutting machines especially built and suitable for cutting velveteens and other fabrics on the bias. Each machine cuts a 4 yard length at a stroke; has self-sharpening knives and adjustable automatic feed; is perfectly balanced, requiring but little power to operate. All are in perfect condition; equipped with fast and loose driving pulleys, feed tables, etc. Can be operated at the rate of from 45 to 60 cuts per minute. Address

E. H. B., Box 165, New York.

Inquiry No. 1595.—For manufacturers of furniture woodworking machinery.

The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $4. Munn & Co., publishers, 361 Broadway, N. Y.

Inquiry No. 1596.—For shaping machinery used in making electric light telephone lighters, railway cross arms and borers for same.

☞ Send for new and complete catalogue of Scientific and other Books for sale by Munn & Co., 361 Broadway, New York. Free on application.

Inquiry No. 1597.—For machinery for making insulating pins.

Inquiry No. 1598.—For dealers in figured wood for veneering purposes.

Inquiry No. 1599.—For launch hulls of steel 13 to 30 feet long to be driven by gasoline motor.

Inquiry No. 1600.—For manufacturers of paper tubes for cigarette making.

Inquiry No. 1601.—For address of manufacturers of machinery for the separation and preparation of American asphalt, both sand and rock.

Inquiry No. 1602.—For parties to manufacture a portable bootblacking device consisting of tricycle and stand combined.

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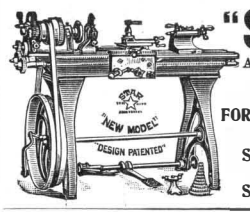

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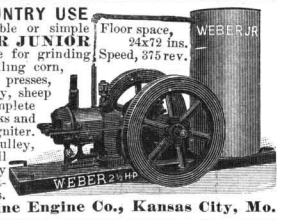

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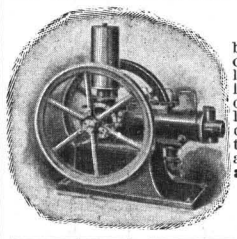
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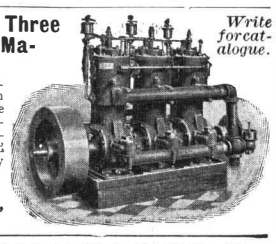
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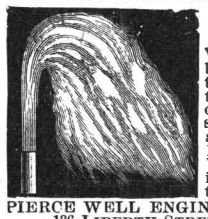
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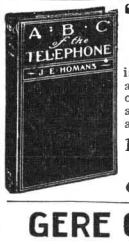

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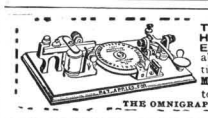
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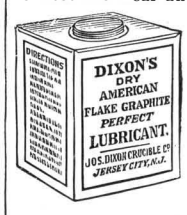

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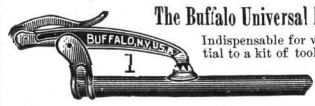

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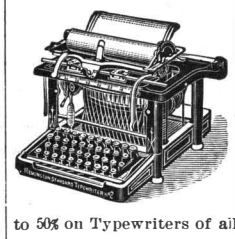
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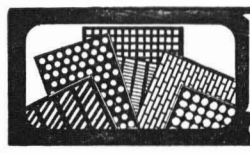

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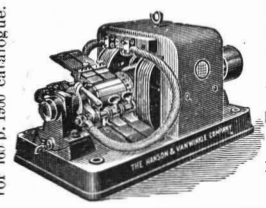

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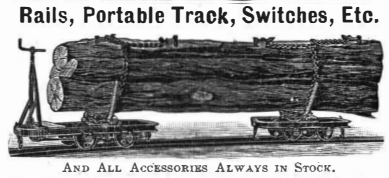

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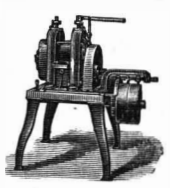

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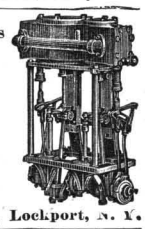

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(8444) F. W. T. writes: I have been informed by lightning-rod men that if a rod be strapped to a roof (wooden or metal) it absorbs all electricity on the roof or in its neighborhood and prevents a discharge of lightning striking roof or rod (wooden or metal). Is this a fact? Is a circuit necessary? A. We think a lightning rod should be attached to a roof at many points, though it is not for the reason that iron absorbs electricity, but because the iron conducts the electricity away. A rod should always go to the ground and terminate in moist earth.

(8445) C. W. B. writes: In your reply to J. G. B. (8379), October 12, "What causes the humming of telephone and telegraph wires?" you say, "The humming of wires is due to the vibration of the wires. The vibration is caused principally by the friction of the wind." Now I have many times heard them hum the loudest when there was, apparently no wind or slightest breeze whatever. Do you not think sudden changing of temperature from warm to colder will cause them to hum? A. When the wind blows hard the wires do not hum to any degree. A very gentle draught of air is best adapted to give a rapid vibration, just as is the case with an Eolian harp. We have often heard them hum when there was no wind at the ground, but there was a breeze at the tops of the poles, somewhere not far away, we are sure. Temperature could not change in iron fast enough to produce a note.

(8446) R. H. asks: 1. The tendency of an electric current is to place a magnetic needle at right angles to it. Why does not the needle ever attain this angle? A. Because the earth's magnetic force tends to pull the needle back into a north and south direction again. The position taken by the needle at any time is such that the force of the current is exactly equal to that of the earth. If the needle is controlled by a magnet, the reasoning is the same as above, only substitute the force of the magnet in place of the force of the earth. An astatic needle will turn so that it stands at right angles to an electric current. 2. Please tell me how to make a preparation which will stain the skin about the color of a Spaniard. I would prefer a compound which will not produce any injurious effects on the skin and wash off easily. A. The pastes and powders used by actors in their making-up will do what you desire. They can be purchased from costumers. 3. I wish to make a scale for a galvanometer; how can I make the scale? A. A scale of degrees is used when the reading of the needle is taken directly. When a beam of light is reflected from a mirror attached to the needle, a scale of equal divisions of any sort may be used and the value of one division found by comparison with a standard instrument. 4. I have heard that an iron bar increases slightly in length on magnetizing. Can you describe to me an apparatus which will show this? Preferably simple. A. A lever which will greatly multiply the motion of the end of the bar will accomplish this. There is no special apparatus for the experiment. The iron core of an electro-magnet is used, and the short end of the lever bears against the end of the core. When the core is magnetized, the long end of the lever moves far enough to be seen, if the apparatus is properly arranged.

(8447) E. R. H. asks: 1. Is liquid air obtainable for experimental and demonstration purposes, and if so, where may it be procured? A. We do not know. Very recently none could be had. If any machine is running we are not aware of the fact. 2. In operating a small hand-power dynamo, the current fluctuates every few seconds, the minimum current being less than one-half the maximum. The speed and the resistance remain constant, the dynamo being connected in shunt. What is the cause and how may it be remedied? A. We suspect that your speed is not as constant as you think. We do not know any other reason for a drop in the action of the machine. 3. What is the minimum spark gap of an induction coil which will operate an X-ray tube and what primary current is required? A. The spark gap depends upon the size and exhaustion of the tube. For the highest effects a coil giving 14 inches spark is required.

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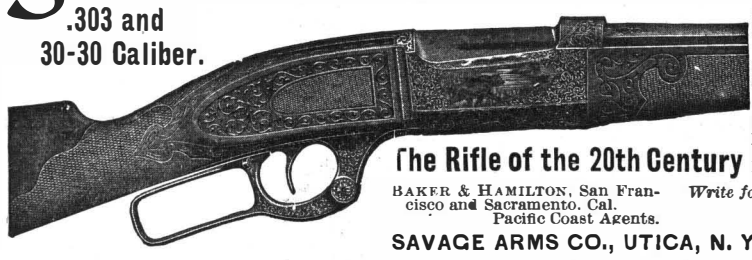

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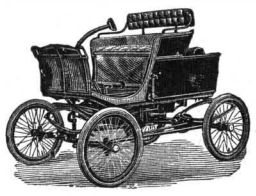

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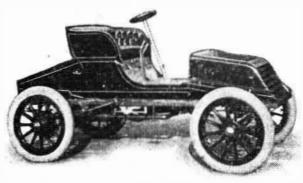
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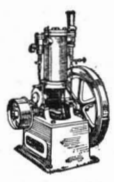
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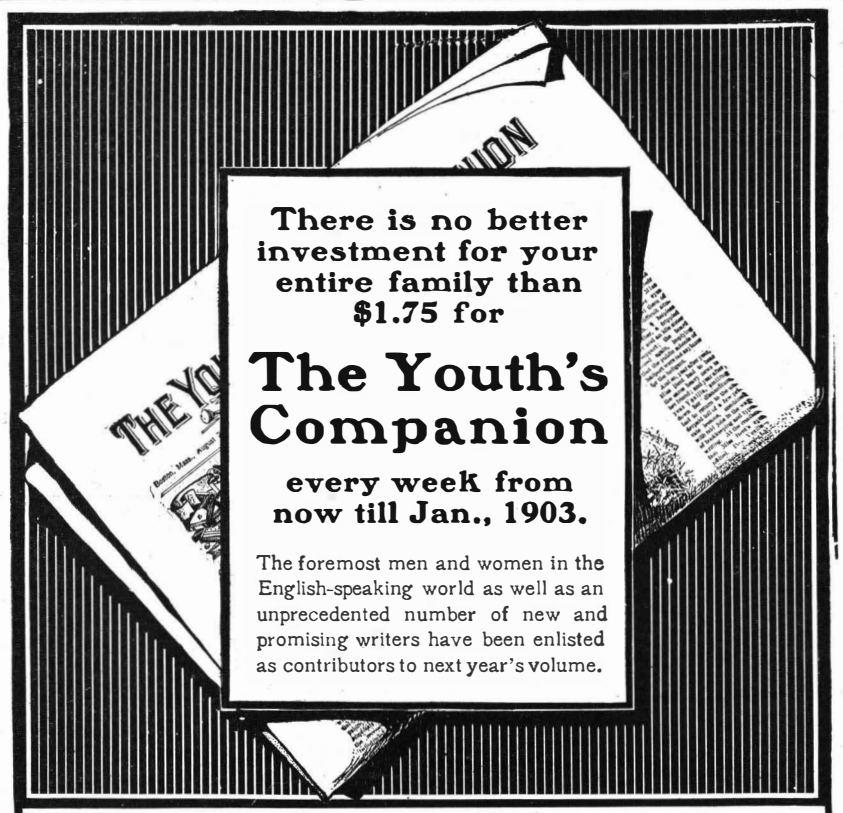
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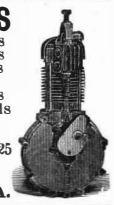
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